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THE PRACTICAL ENGINEER

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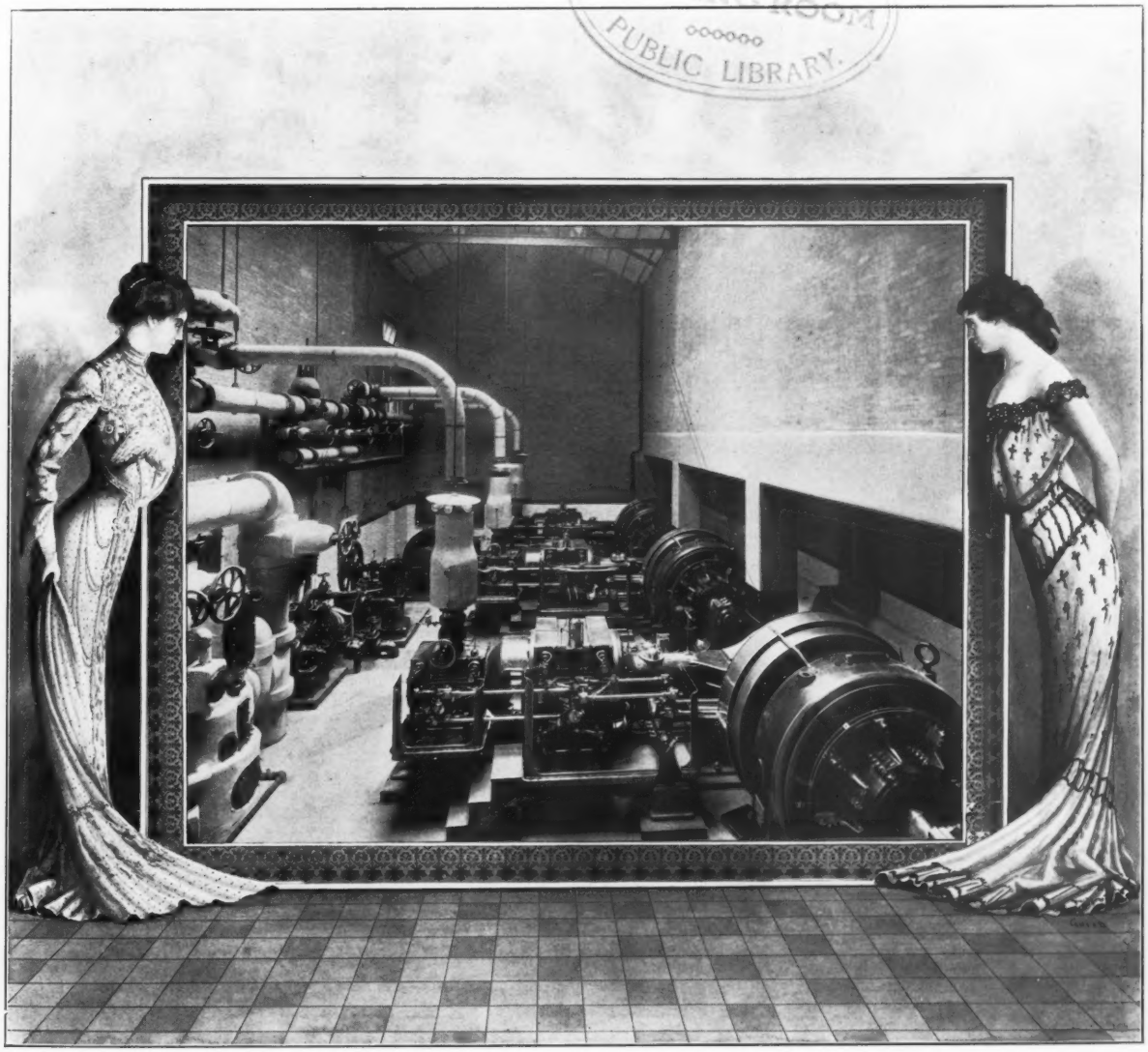

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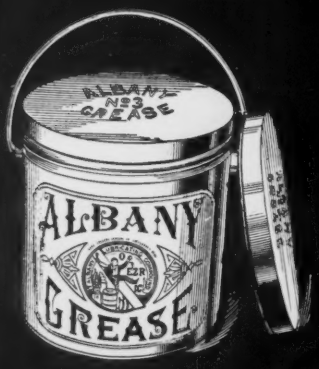

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The
Practical Engineer

A monthly journal, devoted to the economical generation and utilization of power and to the interests of stationary engineers

VOL. VIII PHILADELPHIA, SEPTEMBER, 1904. No. 8.

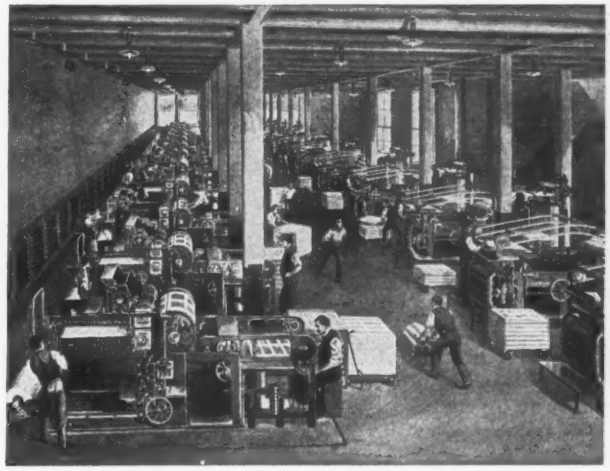
The Mechanical Plant of the "Ladies' Home Journal" and "Saturday Evening Post."

A Plant Where 4,000,000 Magazines are Printed Each Month.

There has probably been no industry that has shown such a degree of progress or such a wealth of invention and ingenuity as the modern printing industry, exemplified in the printing of the weekly or monthy magazine. Not alone is it necessary to assemble together the suitable material and illustrations with which the paper or magazine is to be filled, but the reading matter must be set in type; cuts made from the illustrations, electrotypes made from them; the printing done in one, two, three or more colors as required; the different forms folded, assembled, bound, trimmed, wrapped, addressed and mailed and as if this were not enough to contend with, the word "time" is the encircling cog wheel into which all these other things must fit. A daily paper must come out at a certain time every day, regardless of other considerations, a weekly magazine must come out on a certain day of the week and a monthly magazine must be equally as regular in its production. Whether it be daily, weekly or monthy, it is constantly a race against time.

As modern machinery has gradually become more adept in the speed and manner with which it turns out the work, the quality of each step has also been necessarily improved. All modern papers of to-day are set with freshly set type for each issue, from which electrotypes are made, these being duplicated as often as necessary. This necessarily makes fresh, clean impressions and together with newly-devised presses and auxiliary devices, it gives a product which the founder of the *Saturday Evening Post* would never have believed possible. As bright a man as Benjamin Franklin was, he would doubtless be overwhelmed with emotions of wonder and incredulity to see 750,000 papers of this magazine which he first printed in 1728 with his old hand printing press, flying from these machines each week, printed in colors, neatly folded and wrapped for delivery. Strange as it might appear, the very agency which Benjamin Franklin brought down from the clouds when flying his kite along the banks of the Schuylkill, is now a potent factor in printing this healthy successor of his paper.

The plant of the Curtis Publishing Company, which is described in this article, not only prints 750,000 28-page weekly magazines, but also 1,100,000 *Ladies' Home Journals* each month. This makes an enormous total of 4,000,000 papers

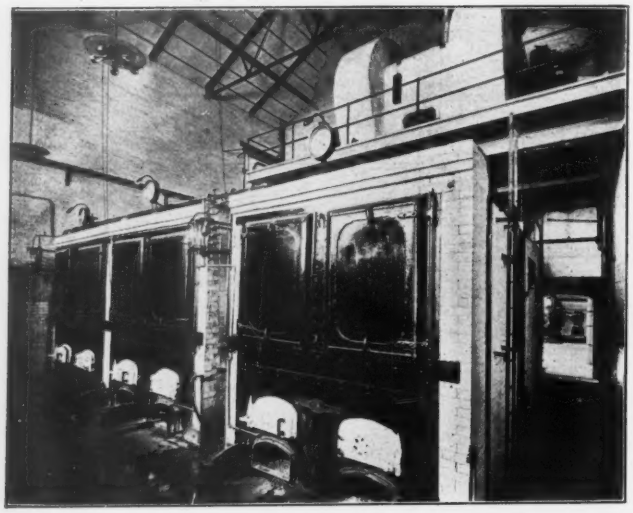


One of the Press-rooms of the "Ladies Home Journal" Plant.

printed each month. In dealing with such large numbers, one fails to appreciate what they mean until it is realized the enormous amount of paper that must be used. A storage capacity of thousands of tons is insufficient to keep this plant running one short month. The paper comes to this plant in rolls of from 600 to 800 pounds and in that form is placed on the presses. The paper passes through them and is printed on both sides in 16-page forms, the press at the same time cutting them to size. They are then folded automatically by folding machines. The largest folding machines are capable

of folding four 16-page forms at one time, inserting them and binding them at the same time into a complete magazine. The smaller folding machines fold each form separately, after which they are inserted and stapled by hand. The magazine is then trimmed and wrapped ready for delivery.

With such a large circulation as mentioned, the printing of the names of the subscribers, which are pasted on the wrapper, alone requires a printing office of no mean size, as well as a clerical force that numbers well into the hundreds.



Boiler Room of the "Ladies Home Journal" Plant, showing blowers for the Economizer.

To divide these two departments, there are two separate buildings, known as the publication and the mechanical buildings. The mechanical building, which is seven stories in height, contains on the top floor, the composition department. The next lower floor contains the addressing department, the fifth, fourth and third floors contain the folding and binding machines, and the wrapping departments. On the second and first floors are the printing presses run by 10 horse power motors, and in the basement are the storage rooms for the paper.

The machines throughout this building are run by direct current motors directly connected to each individual machine. The motors for running the presses vary from 5 to 10 horse power and are of the Westinghouse type. In order to facilitate the operation of carrying the magazines from one floor to another, four conveyors are used, which are each run by a 5 horse power motor. The mechanical building contains two Morse-Williams freight elevators.

The engine and boiler rooms are situated on the first floor of the mechanical building, an annex having recently been constructed for their use. The engine room is well lighted with a skylight which is a considerable distance above the engines, giving plenty of head room, the walls being cheerfully lined with light faced brick. It contains four Harrisburg engines directly connected to Westinghouse generators, a feed water heater, two service pumps and a blower. On one end of the engine room, located on a gallery, is the switchboard. Three of the Harrisburg engines are of the four valve compound type, the cylinders of which are 14½" x 28" x 18". They are rated at 300 horse power when running at a normal speed of 200 revolutions per minute and are each connected to 200 kilowatt Westinghouse generators which supply current at a constant potential of 230 volts. The fourth Harrisburg engine is an 80 horse power simple engine having a cylinder 11" x 12" and runs direct connected to a 50 kilowatt generator; the speed of this unit being 275 revolutions per minute. The electricity which these dynamos generate is used for running the motors throughout the building as well as lighting the two thousand or more incandescent lamps and one hundred enclosed arc lamps.

The steam comes to the engines in well rounded bends, there being a Stratton separator on each main at the engine. The low pressure cylinders of the compound engine have on them a Sterling force feed lubricator. The engine room also contains a 600 horse power Cookson feed water heater which heats the water to a temperature of about 208 degrees. The two pumps in the engine room are used for the fire service and service tanks. The larger pump is a single acting triplex Worthington 8" x 10" with outside plungers. It is driven by a 15 horse power motor, the pump having a capacity of 150 gallons per minute. It is regulated automatically by a float in the tank at the top of the building. The smaller pump is run by a 7½ horse power motor and has a capacity of 90 gallons per minute. It is a triplex double-acting pump with 4" x 6" cylinders. At one corner of the engine room, there is a 7½ horse power General Electric motor geared to a Wilbraham-Green suction blower which is used for running the pneumatic tube system throughout the building.

The switchboard is made of white marble and consists of six panels: four are the generator panels and two the distributing panels. Each generator panel contains a Weston ammeter and voltmeter, Thompson wattmeter, Ward-Leonard rheostat, Cutter circuit breaker and generator knife switch. The feeder panels contain the station voltmeter and ammeter and the required distributing knife switches. A small switch on one of these panels makes the station voltmeter available for use as a voltmeter on any of the station units or as a ground detector. There is also a switch on one of these panels which makes available the outside street current in cases of emergency.

The steam for the engines is generated by three 250 horse power Babcox & Wilcox water tube boilers, which are fitted with McClane-Brook's shaking grates. Buckwheat anthracite coal is used for fuel. The boilers are fitted with the usual fittings, quick-closing gauge cocks and besides the ball lever safety valve, each boiler is equipped with an Ashton pop safety valve and carries 140 pounds of steam. The feed water for the boilers, after passing through the feed water heater, is heated in a Green economizer to a temperature of about 250 degrees. The boilers work with induced draft, the flue gases being drawn up through the economizer by means of two 120-inch American blower fans, each of which is connected to an 8 horse power motor. A one horse power motor drives the scraper for keeping the tubes free from dirt. The whole arrangement of economizer, blowers and scraper is situated on top of the boilers, the motors for which are controlled from the boiler room floor with Cutter-Hammer regulators. Besides the boilers, the boiler room contains the coal storage vault, blow-off tanks and ash lift and injector.

Below the boiler room is the pump room, which contains the boiler feed pumps, vacuum pumps and traps. There are two Warren vacuum pumps, 6" x 7½" x 7", connected to the Warren-Webster system of exhaust heating. The feed pumps con-

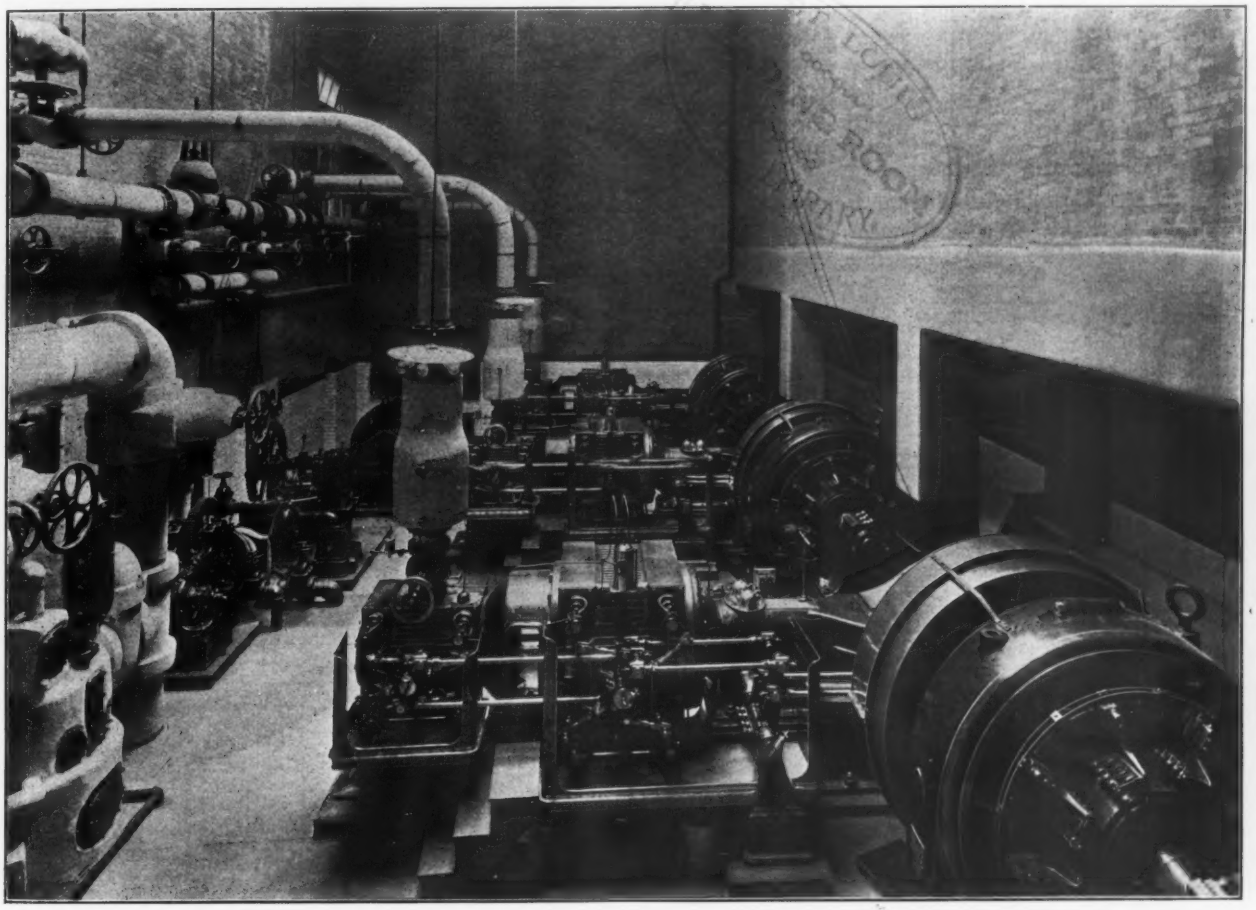
sist of two 4" x 6" triplex single-acting Gould pumps driven by 2 horse power motors and a 3½" x 4" triplex pump operated by a one horse power motor. A 2" x 3" x 2" Worthington pump takes care of the oil and water from the exhaust pipe. In case of failure to the pump, there is a Kieley and Mueller low pressure trap ready to perform this duty. Two Kieley and Mueller high pressure traps take care of the drips from the heater and the separators. The piping throughout the building is covered with asbestos covering. The exhaust pipe from the engines contains an 18" Kieley and Mueller back pressure valve.

The only mechanical apparatus of interest in the publication

The Value of Oil in Transformers.

As the use of transformers became more general in the early years of the application of the alternating current, it was found that those in use possessed numerous defects, which were of constant annoyance, among them being the breakdown of the insulation, overheating and the more or less oxidation of the insulation. To overcome these difficulties the transformers were submerged in oil and, in large sizes, this practice is now almost universal.

Oil in a transformer can be said to possess three distinct purposes: First, it increases resistance against breaking down of the insulation and re-insulates punctures in the insulation.



Engine Room of the "Ladies Home Journal" and "Saturday Evening Post", showing engines, feed water heater, motor-driven pumps and model system of piping.

building is the elevators. The passenger elevator is of the hydraulic type, which is run by a rotary Quimby pump directly connected to an Eckmier motor. The freight elevator, having 3 tons capacity, is of the drum type, run by a Westinghouse motor.

Mr. Williams is the superintendent of the mechanical department and Mr. Patrick Collins is the chief engineer of this very complete and well-kept plant.

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Coal production in the United States, according to the Geological Survey report, shows 359,421,311 tons mined during 1903, an increase of 58,000,000 tons over 1902.

Second, it reduces the temperature. Third, it preserves the insulation from oxidation.

Experiments have shown that where a potential will jump through one inch of air, it will only jump about one-fifth that distance in most pure oils so that if the spaces around the coils of a transformer are filled with oil, the resistance to breaking down of the insulation will be very much increased. Not only this, but should the insulation be pierced by a high potential discharge, the oil will flow into the puncture and in a great measure re-establish the insulation. Insulation is often punctured by a discharge of electricity of very high voltage, due to many artificial causes, as static electricity in which the current is often very small and causes no actual damage other

than a minute puncture of the insulation betweeen the primary and secondary. Such a puncture, when filled with oil, does not greatly reduce the value of the insulation.

In regard to the oil reducing the temperature, it is done either by pumping a continuous flow of oil through the transformer, thus carrying away the heat, or cold water is forced through coils of pipes in the transformer case, which takes up the heat from the oil. Water cooled transformers using oil as an insulator have been built as large as 2000 K. W. capacity and upward.

In regard to the prevention of the oxidation of the insulation, a transformer, if used without oil for a long period, will show signs of deterioration of the insulation, as it will become brittle, due to the constant heating. Oil prevents the access of air to the insulation and all oxidation is prevented and the insulation retains its original pliability, thereby increasing its life.

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Methods for Measuring the Clearance of a Steam Engine.

The clearance of a steam engine can be measured either by filling the clearance space with a known amount of water or else it can be obtained by calculating from the drawing of the engine.

To measure the clearance by actual test, the engine is carefully set on centre, with the piston at the end where the measurement is to be taken. Assuming for example, a Corliss engine, the best method to pursue is to remove the steam valve so as to have access to the whole steam port and then fill up the clearance space with water, which is poured into the open port through a funnel. The water is drawn from a receptacle containing a sufficient quantity, which has been previously measured. When the whole space including the port has been completely filled, the quantity left is measured, and the difference shows the amount which has been poured in. The measurement can be most easily made by weighing the water, and the corresponding volume determined by calculation, making proper allowance for the temperature. The proportion required is the volume in cubic inches thus found, divided by the volume of the piston displacement, also in cubic inches, and the result expressed as a decimal. In this test, care should be taken that no air is retained in the clearance space when filled with water.

The only difficulty which arises in measuring the clearance in this way is that occurring when the exhaust valves and piston are not tight, so that, as the water is poured in, it flows away and is lost. If the leakage is serious, no satisfactory measurement can be made, and it is better to depend upon the volume calculated from the drawing. If not too serious, however, an allowance can be made by carefully observing the length of time consumed in pouring in the water; then, after a portion of the water has leaked out, fill up the space again, taking the time and measuring the quantity thus added, determining in this way the rate at which the leakage occurs. This will give data for the desired correction.

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What is said to be the largest electro-magnet in the world has been installed in the Bridgeport (Conn.) Hospital, for extracting pieces of iron and steel from the eyes of machinists and other metal workers who may be injured.

INDICATOR MOTIONS.

Methods of Reducing the Length of Stroke for Indicator Use.

An indicator card must show accurately the steam pressure that acts on the piston throughout the stroke and the position of the piston when that steam pressure acts. That is, the indicator diagram is the resultant of two motions at right angles to each other. The correctness of the steam pressure depends upon the accuracy of the indicator spring and the correct position of the piston, as represented on the indicator card, depends upon the accuracy of the indicator motion. If these motions are not proportioned to their respective values, then the indicator card will not tell the exact truth.

Of the two errors which are likely to creep in, the one usually found to be the most important is that due to incorrect indicator motions, so that it is important when taking a card that the correctness of the motion be investigated. The easiest method to do that is to connect up the indicator motion and the indicator in the exact position in which the indicator cards are to be taken but have the spring in the indicator removed.

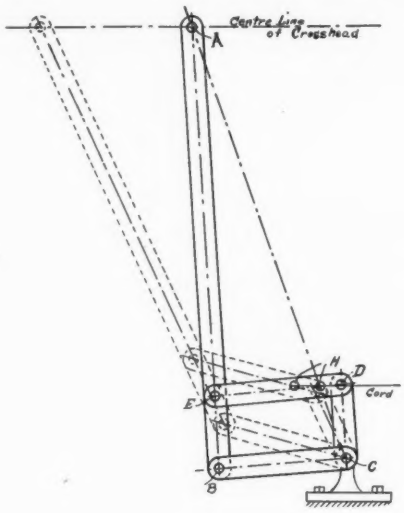


Fig. 1.

Put the engine on one centre and draw a vertical line on the indicator card by pushing the indicator pencil up and down by hand. Then put the engine on the other centre and draw another line on the indicator card. Divide the stroke into a number of equal parts and move the crosshead corresponding to the different positions, each time making a mark on the card with the indicator pencil. There will then be as many different marks on the indicator cards as there were positions of the piston, and if the indicator motion is correct, these lines will be equal distances apart. The best way to do that when the crosshead is not enclosed is to describe a line on the crosshead guide corresponding to each centre and divide the distance between them into some number of equal parts, preferably small distances apart. The mark on the crosshead is then brought opposite each of these marks and the proportional distance that the piston has moved is known. Care must be taken in doing this, as well as in putting the engine on centre, that the engine is always turned in the same direction so that the lost motion will not distort the true position and if in turning the engine over, the crosshead moves further than ex-

pected, do not bring the engine back just enough as required but bring it back a much greater distance and bring the engine up to the mark as before. This will prevent any lost motion from interfering with the correctness of the experiment.

Indicator motions may be divided into two classes: Those

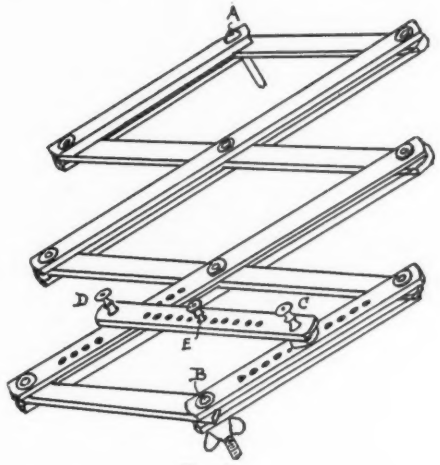


Fig. 2.

that are absolutely correct in principle and those that are approximately correct. The well-known motion known as the pantagraph belongs to that class which is absolutely correct. Fig. 1 represents one form. It consists of four levers, AB, BC, CD and DE. The point A is connected to the crosshead of the engine and the point C is connected to some fixed point, usually for the sake of convenience to some point directly under the mid position of the crosshead. H is the point of attachment of the indicator card and must be located in a line joining C and A. It will then always travel in a line parallel

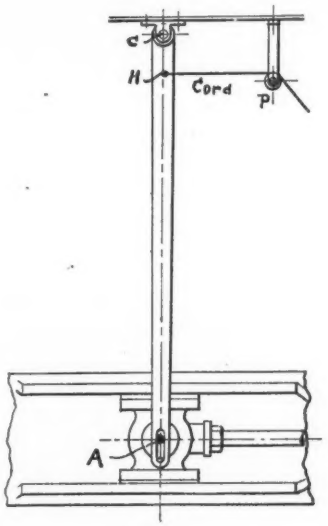


Fig. 3.

to that in which A moves. The points A, H, and C always being in straight line, the movement of H compared to the movement of A, which is the length of stroke, depends upon its distance from the fixed point C, or, according to proportion,

$$AC : HC :: L : H$$

in which L is the length of stroke and H is the required length of indicator card, or

$$HC = \frac{H \times AC}{L}$$

In this equation, H is the length of indicator card, say 4

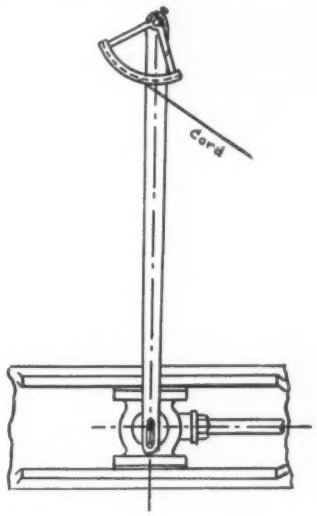


Fig. 4.

inches, AC is, say, 12 inches and L, the length of stroke is 12 inches, then

$$HC = \frac{4 \times 12}{12} = 4 \text{ inches}$$

so that the indicator card would be attached along the line CA about 4 inches from the fixed point C. In general it may be said that when the lever AB is made about equal to the stroke, the levers DE and BC may be made equal to 1-3 or 1-4 of AB and the length of DC will approximately be equal to HC ob-

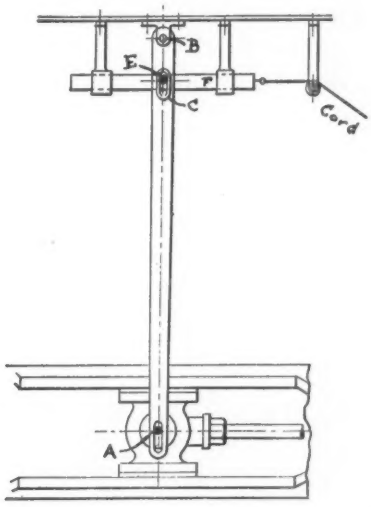


Fig. 5.

tained from the above calculation so that the point H can be located exactly. The dotted outline of the pantagraph shown in Fig. 1 represents the position of the links at some other part of the stroke.

Another form of pantagraph which is much used is called the lazy tongs, and is shown in Fig. 2. The advantage of this

arrangement is that it can be used as well vertically as horizontally. It is usually connected at A to the crosshead of the engine at whatever part is the most available, the opposite end B being connected to some fixed point. If it runs horizontally,

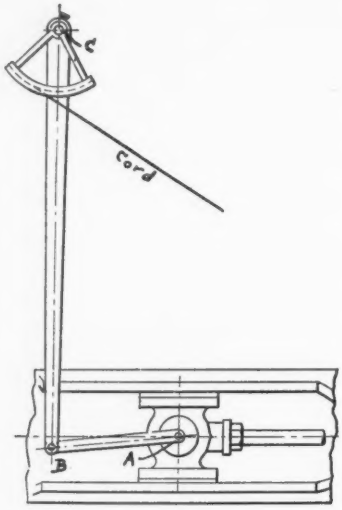


Fig. 6.

it is usually fixed to a post connected to the floor or if run vertically it can be connected to some part of the engine frame or can be fastened to an angle iron secured to the floor. The indicator cord is connected to the cord pin at E. The position of the cross bar CD can be changed to suit variable conditions of the stroke if used on different engines, or, to change the length of the indicator card if used on the same engine, but under all conditions the pin E must be exactly in line with the centres A and B.

A simple method used for obtaining the required indicator motion and one frequently used by engineers is the pendulum motion, shown in Fig. 3. It belongs to that class of motions which is only approximately correct, but when designed properly, the error involved is negligible. The pendulum or lever should be made quite long, usually about twice the stroke of the engine, the point of suspension of the indicator cord being determined by the length of the card required. As before, if L = length of stroke and H = length of card required, then

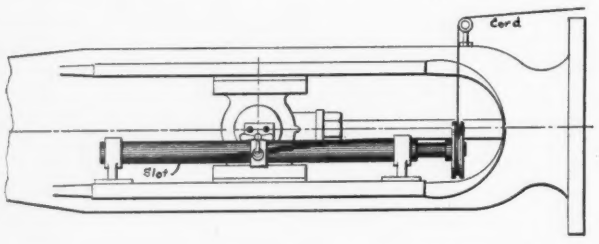


Fig. 7.

the distance $CH = \frac{H \times AC}{L}$ which gives the distance that H is from C. The arm AC should be suspended from a point directly over the mid-position of the crosshead travel. The pulley P should be placed directly in line with the point H when in its vertical position, so that the indicator cord will be exactly horizontal. The cord from the pulley P can then be led to the indicator. This reducing motion can be easily set up and while the motion is not mathematically correct, it will give fairly good results.

In case it is inconvenient to use a guide pulley P to lead the cord from H, and which must be done to obtain anything like a correct motion, a segment of a circle having its centre at C may be substituted, as shown in Fig. 4, and when the pulley can be placed in the same plane with the indicator pulley, the use of the guide pulley can be dispensed with and the cord on the segment may be run directly to the indicator. This segment is called a Brumbo pulley and should be made large enough so that the indicator cord is tangent to the circumference at all portions of its movement.

The arrangement known as the suspended lever motion is shown in Fig. 5. Instead of having either the guide pulley or the Brumbo pulley, it uses a sliding bar which is made to move proportional to the movement of the crosshead and gives a motion which is accurate throughout the whole stroke. It consists of a lever suspended at B to a bracket, which is secured to the ceiling or a suitable support. The lever is slotted at A and at C and is driven by the crosshead pin at A. The slot at C is engaged with a pin E fastened to a sliding bar F

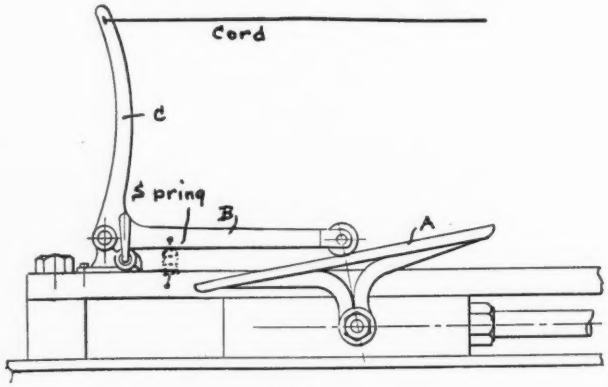


Fig. 8.

which slides in a pair of brackets. The indicator cord is attached to the sliding bar and passes over a pulley in line with the bar. By this arrangement, the bar F is made to move parallel to the crosshead and gives a correctly reduced motion to the indicator cord.

An arrangement that does away with the slot on the end of the lever is shown in Fig. 6. The lever CB is connected to the crosshead by means of lever AB. The lever AB is made about 1-3 the length of CB. In this arrangement, care must be taken where the fixed point C must be located. As the point A travels in a straight line and the point B in an arc of a circle about A, the point C should be so located that the end B should be as far below the line of movement of the crosshead, when on its centre of travel as it will be above the line at the extreme end of the stroke.

There are many other modifications of the above arrangements but except that they are more complicated, they do not have any particular advantages over those shown.

Instead of making use of a number of levers, very good and correct motions may be made by using the inclined plane principle or the principle of reducing wheels. The Pennsyl-

vania Iron Works makes use of the inclined plane principle as embodied in the screw and mention of which was made in the April issue. It consists, as shown in Fig. 7, of a bar about 2 inches in diameter mounted parallel to the piston rod. A helical slot is cut in the shaft so that when the engine travels

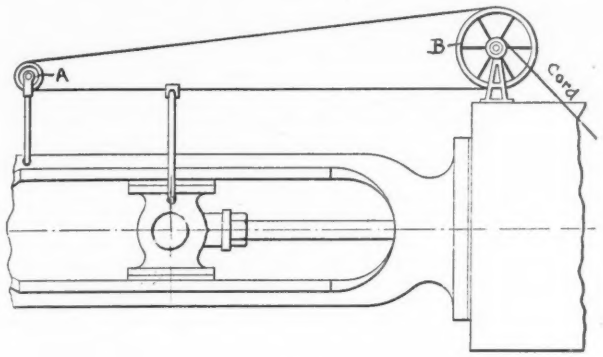


Fig. 9.

the full length of the stroke, the bar revolves enough to give the indicator the required motion. A pin attached to the crosshead engages with the slot in the shaft and by turning the handle, the sliding key can be engaged or disengaged. The indicator cord is attached to the pulley on the end of the shaft. This is an absolutely correct motion as the movement in a rotative direction is exactly proportional to the length of the stroke. The length of the indicator card can be varied if necessary by changing the diameter of the pulley on the end of the shaft. From the pulley the cord is led by properly placed pulleys to the indicator.

The inclined plane principle is one which has been in use a long time with short stroke engines. As shown in Fig. 8, it consists of an inclined plane A, which is attached to the crosshead. One end of a bell crank lever B, on which there is a smooth pulley, is held down on this plane by means of a spring and the other end C, is connected to the indicator cord. As the roller moves up and down it imparts the proper motion to the indicator drum. This form of motion is only adaptable for short stroke engines, as the end of crank C moves in the arc of a circle and if the stroke was long, it would give a motion which would not be accurate. As it is, it is only an approximate movement. The length of the card can be varied by changing the angle of the inclined plane. A small cam is used for engaging and disengaging the levers.

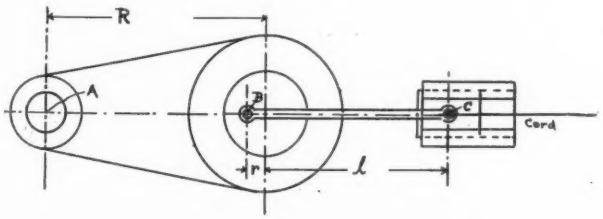


Fig. 10.

The motion of the crosshead can be very easily reduced by means of different size pulleys which gives a very accurate diagram. As generally used, with long stroke engines, it consists of two pulleys, A and B, connected together by means of a continuous cord, as shown in Fig. 9. The lower cord, to which the crosshead is attached by any convenient extension, must be parallel to the centre line of the piston rod. On the axle of pulley B, there is a smaller pulley from which the indicator derives its motion. Any length of card may be had by changing the size of this pulley.

All of the motions described above are adapted only when they can be connected to the crosshead. In the case of a trunk engine or where the crosshead is inaccessible, other means of obtaining the correct reducing motion must be devised. It is usually possible in this case to make use of the end of the crank shaft to get the desired motion by using either the crank reducing motion or an eccentric, which is a modification of the crank principle. When the crank principle is used, the centre of the crank is located about 2 inches from the centre of the shaft in order to get a diagram of the required length. Fig. 10 shows an ararngement in which the motion of the piston is exactly reduced. Care must be taken with this arrangement so that the point B be placed in the same relative position to the centre of the shaft as the point A, and the length of the indicator connection connecting rod *l* should bear the same relation to length of the connecting rod of the engine, L, as R, the radius of the crank, bears to *r*, the radius of the indicator motion or, as,

$$r : R :: l : L$$

The indicator cord is attached to point C or to any extension of the crosshead which has the same motion.

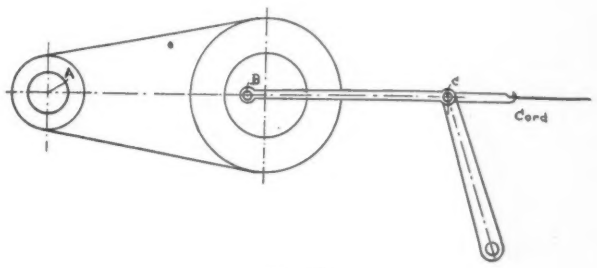


Fig. 11.

A somewhat simpler arrangement shown in Fig. 11 does away with the crosshead but does not give so accurate a motion on account of the end of the rod C moving in an arc of a circle instead of in a straight line. The same proportions must be followed between the position of the point B and the radius of the crank and the length of rod BC and the length of the connecting rod of the engine. For instance, if the point B be a distance of 2 inches from the centre of shaft and the length of the connecting rod is 4½ times the radius of the crank, then the rod BC will have to be 9 inches long in order that the point C shall move proportionally to the movement of the crosshead or piston.

When an eccentric is used in the place of a crank, it is put on the end of the shaft and all the proportions above mentioned must be adhered to, in which the radius of eccentricity replaces the radius of the crank and the length of the eccentric rod the length of the connecting rod of the indicator motions.

In all indicator motions, the important feature of lost motion in the joints must be eliminated, because this will give an incorrect diagram, but since there will always be some little lost motion or vibration in the ordinary rig, any of the above mentioned motions will be as accurate as necessity demands. The length of the card required depends upon the number of revolutions of the engine to be tested. In slow speeds, a long

card may be taken, but with high speeds it is well to have a short card in order that the effects of inertia of the paper drum of the indicator will be as small as possible.

STEAM TURBINES.

Comparison of the De Laval, Parsons and Curtis Types.

By R. T. Strohm.

PART I.

At the present time the steam turbine is making an urgent bid for popular favor as the most economical steam motor, and there is considerable conflict between it and the reciprocating engine regarding the steam consumption per horse power per hour. This is the basis to which all results must be reduced before comparison can be made, and even then the conditions must be approximately the same in all cases, in order to make fair and conclusive comparisons. There are three principal types of steam turbine in the United States to-day, and they are the De Laval, the Parsons, and the Curtis.

The first, which is perhaps the oldest of the commercial types, consists simply of a single set of vanes placed along the circumference of a comparatively narrow disk, the disk being firmly fixed to a light shaft passing through its centre. The steam is admitted through four nozzles set at ninety degrees to one another, and is ejected from these nozzles against the curved vanes, imparting motion to them, and rotating the shaft. Fig. 1 serves to illustrate the principle upon which the De Laval turbine operates. It will be seen that, after being delivered to the vanes, the steam escapes, doing no further work. That is, all the work performed by the steam is done upon the single row of buckets at the circumference of the disk, making it a single-stage engine.

The De Laval turbine is an impact turbine. That is, its motion is derived from the impact of the steam jets against the vanes. It makes use of the high velocity of the steam to propel the wheel, by forcing the expanded vapor to give up its

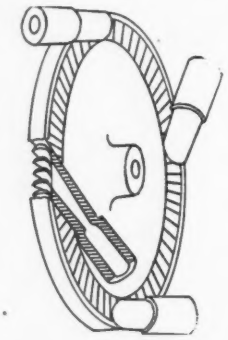


Fig. 1.

kinetic energy, or energy of motion. This enery of motion is due to the high velocity of the steam as it leaves the nozzle and impinges upon the blades. Manifestly, the greater the velocity, the greater the kinetic energy, and hence the more work obtainable from a given amount of steam. To obtain high velocity of the steam jet, the nozzle is made divergent. That is, its diameter grows gradually larger in the direction of the turbine wheel. As an increase of diameter means an increase of area, it is evident that the steam expands as it moves through the nozzle on its way to the turbine. Fig. 2 shows a longitudinal section along the axis of a nozzle and clearly illustrates the enlargement of the cross-section.

A pound of steam, on entering the little end of the nozzle, has a definite amount of static or pressure energy. Its passage through the nozzle is exceedingly rapid, and its expansion is correspondingly rapid. In other words, the expansion is practically adiabatic, which means that there is no heat lost or gained from any external source during the change of volume. But this expansion has brought about a great change in the properties of the steam. Where it previously had a high

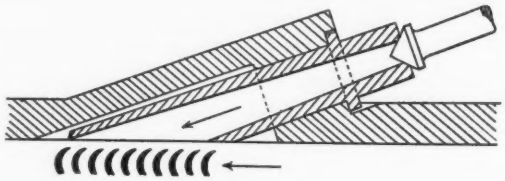


Fig. 2.

pressure, it now has a low pressure, corresponding to the pressure at the exhaust. This means that its static energy, or energy due merely to pressure, has been greatly reduced. Now, it is impossible to destroy energy. It can be transformed, but never destroyed. During the adiabatic expansion, no heat was lost, and hence we must conclude that the steam has just as much energy after its expansion as before. But since its pressure is so much lower, it simply cannot have the same static energy. As a result, we at once look for a re-appearance of this apparently lost energy in some other form, and we find it in the velocity of the jet. Where, previously, the steam had a certain pressure and velocity, we now find it to have a much lower pressure and a much higher velocity, so that the effect of the expansion has been to transform the static energy into kinetic energy.

The reason for making this transformation must be apparent. The De Laval turbine is a single-stage turbine, and after the steam has passed through the wheel, there is no way of further utilizing its heat energy, so far as the turbine itself is concerned. Consequently, it is not only desirable, but imperative, that the steam admitted shall give us a maximum amount of energy to the single row of vanes, and this is accomplished by obtaining the greatest possible velocity of the steam at the moment it is delivered to the wheel.

The velocity of the steam as it leaves the expansion nozzle varies, according to conditions, from 2000 feet per second to 4400 feet per second. The pressure of the steam upon entering the nozzle, and the amount of moisture it contains, as well as the pressure existing in the exhaust chamber of the turbine, all combine to alter the final velocity. A velocity of 2000 feet per second is obtained with steam at 45 pounds pressure, containing in the neighborhood of 10 per cent. of moisture, expanded down to the atmospheric pressure. With steam of 200 pounds pressure, superheated 200 degrees, and expanding down to a vacuum of 27.5 inches, a velocity of 4400 feet has been obtained.

Now, the maximum efficiency with impulse wheels is reached when the peripheral speed of the buckets is about half that of the moving fluid. Or in the case of the turbine, the best conditions of operation are obtained when the velocity of the vanes is about one-half that of the steam. Hence we find that for

maximum theoretical efficiency, the turbine velocity will be 950 and 2100 feet per second respectively, for steam jet velocities of 2000 and 4400 feet per second. In practice, the speeds vary between 500 feet and 1400 feet per second.

Of course, with such a high rim speed, the rotative speed will also be exceedingly high, and it is found that between the largest and the smallest sizes, the speeds vary from 10,000 to 30,000 revolutions per minute. These are much too high for direct connection to electrical machines, and hence a reducing gear is employed, the reduction ordinarily being 10 to 1. In order to produce quiet action, these gears are helical.

The turbine wheel is thick and heavy near the shaft and tapers away rapidly toward the outer circumference, as illustrated in Fig. 3. The buckets, which are individual parts, are inserted into slots cut in the wheel rim. It will be noticed that near the outer circumference the thickness of the disc or wheel is much reduced. The reason for this is that of safety. If the wheel were of uniform thickness throughout, and a portion of the rim should break off under the effect of centrifugal force, this heavy part might do considerable damage. By using a tapering section, however, and reducing the thickness materially near the outer edge, the weakest spot in the wheel is at *a*. Hence, if the wheel fractures under high speed, the break will occur at this narrowest section, and instead of throwing off heavy pieces of the rim, the lighter parts, comprising the buckets and the rim into which they are inserted, will be free. These, because of their smaller weight, are not able to do as much damage, and may be easily kept within the protective casing of the wheel, which would not be the case with large and heavy parts.

The governing of the De Laval is accomplished by a fly-ball

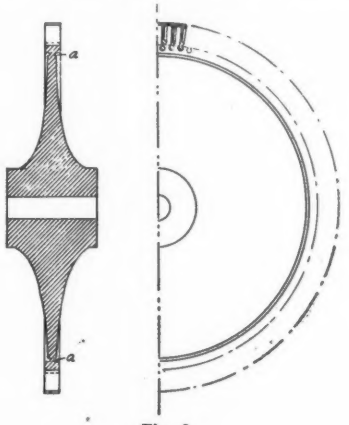


Fig. 3.

governor which acts upon the steam in the supply pipe, throttling it and thus reducing its pressure. This, of course, reduces its energy and is usually the only mode of governing required for a non-condensing turbine. If run condensing, the throttling governor will not control the speed when the turbine is under no load. For even if the steam is throttled to below atmospheric pressure, it still tends to accelerate the speed of the turbine when running light. So a second governor is used, whose purpose is to admit air to the condenser, thus breaking the vacuum, and this increase in the resistance prevents disastrous increase of speed. The latter governor begins to act only when the throttling governor is no longer able to effect a reduction in speed.

The only parts of the turbine subjected to wear are the bearings, the reducing gears, and the vanes. The first are kept in good condition by the use of ring oilers, where the speed is not so high as to cause undue vibration of the shaft which would prevent the proper action of the rings. In case the speed is great, wick oilers are used, and they answer the purpose quite satisfactorily. The helical gears are made of soft steel and the pinions on the shaft are of nickel steel. Little oil is used in lubricating them, and considering that they run at a rim speed of 100 feet per second, their wear is not surprising. The wear on the vanes is of an erosive nature, due doubtless

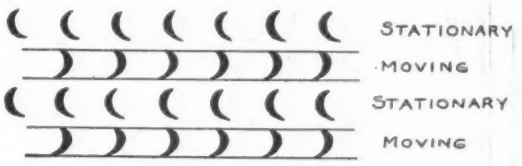


Fig. 4.

to the presence of moisture and grit in the steam. These, striking the buckets at high velocity, have a tendency to cut and score the metal, much as a sand blast will do. This wear is confined, for the greater part, to the inlet edges of the vanes.

The De Laval turbine, because of its very high rotative speeds, is confined mainly to units of less than 300 horse power, being used in the smaller sizes for driving generators, feed pumps, blowers and centrifugal pumps. In the last-named field especially, it has met with considerable success.

The Parsons turbine is radically different from the De Laval both in construction and principles of operation. Instead of a single wheel, it is made up of a large number of separate turbine wheels placed side by side on the same shaft, and the expansion of the steam is continued throughout the entire series. In other words, the Parsons turbine makes use of the successive expansions, each of comparatively small extent, by which the steam is given a series of decreasing pressures accompanied by corresponding increases in velocity. It thus become a multi-stage apparatus.

Alternating with the rows of moving vanes are rows of stationary buckets, as illustrated in Fig. 4. The steam, on leaving the inlet nozzles, first strikes a row of moving buckets, to which it gives up a portion of its energy. It then recoils against the next row of buckets which are stationary, and as they face in the opposite direction, the direction of flow is again abruptly changed so as to cause the steam to act upon the next row of moving vanes. Each step is accompanied by a slight expansion which converts static energy into kinetic energy and enables the steam to do further work on the blades. Besides giving up kinetic energy, the pressure of the steam is also made use of, and a portion of the work done is due to the action of the steam pressure. The Parsons type therefore becomes a combination of the impulse turbine and the reaction turbine.

The number of rows of vanes, both stationary and movable, varies between 30 and 40, according to the size of the turbine. Since the expansion is carried out through a large number of stages, it is apparent that the velocity of the steam is not so great as in the case of the single-stage wheel and that the rotative speed of the multi-stage wheel is therefore less, since

the velocity of each circle of vanes will need to be only a small part of the steam velocity.

It must be evident that as the steam progresses on its way through the successive sets of blades its volume is increased, since continuous expansion is taking place. To make room for the passage of the increased volume, the spaces between the buckets in the several rows are regularly and successively increased in area, by lengthening the blades or buckets. There is, of course, a limit to which these may be increased, and when this limit is reached, the only method of further increasing

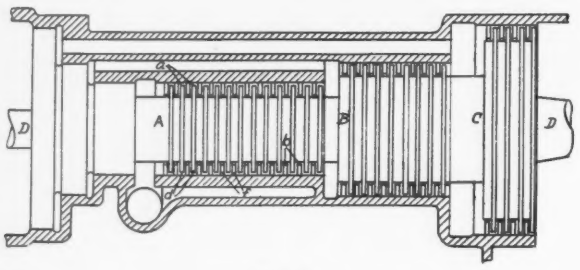


Fig. 5.

the area of the passages is to enlarge the diameter of the turbine. This gives a greater number of blades along the increased perimeter, resulting in a greater area of steam passage. In Fig. 5 is shown a longitudinal section of the revolving part of a Parsons turbine. It will be observed that there are three diameters of turbines, at *A, B,* and *C,* and that as the diameters of the rows increase, the number of rows rapidly decreases.

The moving vanes are fixed to the shaft *D,* as at *d, d, d,* while the stationary vanes *f, f, f,* are attached to the shell or casing. The clearance between the moving and the stationary rows, measured in a direction parallel to the shaft axis, is from one-eighth inch to one-half inch, depending upon the size of the blades. This makes it practically impossible for the blades to interlock or meet, as the rotating part has no axial motion as great as this. However, accidents may occur due to damaged blades in the process of assembling or erecting the machine. New pipe lines should be thoroughly cleaned by blowing a stream of high-pressure steam through them to remove all scales and chips, and a strainer used on the steam inlet pipe, to prevent ingress of foreign materials with the steam current. Even if they did enter, they could hardly pass the first row of stationary blades, but it is best to keep them out altogether.

Turbine and Reciprocating Engines Used Together on Torpedo Boats.

The London *Graphic* says that an innovation in the machinery of the torpedo boat was the subject on the Thames, of an interesting experiment—a trial trip by a first-class 140-ton torpedo boat from the Greenwich yards of Messrs. Yarrow. Experiments in the comparison of the turbine with reciprocating machinery, in the vital matters of speed, economy and general efficiency, had shown Messrs. Yarrow that a turbine-driven vessel was not so satisfactory as one fitted with reciprocating engines. What would a combination of the two do? It did 25 knots. The trip of the torpedo boat built as an experiment showed, in its run from Greenwich to Southend and back to the Temple Pier on the Victoria Embankment, that this speed was fairly easily made. And there was no nerve shattering vibration. Turbine and reciprocating engine in perfect unison drove the vessel through the water as clean as a knife. Professor Rateau's turbines actuate the two side shafts, and the central shaft is actuated by a small triple expansion reciprocating engine of about 250 horse power. When full economy is of paramount importance (during long cruises) the economical reciprocating engine does all the work. When speed—of the sort that drove the Japanese torpedo boats to within torpedo range at Port Arthur and back again to safety—is the thing, the combined engines do the work between them. It is a very happy combination so far as it goes; but at present Messrs. Yarrow are not satisfied that even this combination is superior to reciprocating engines alone. But the turbine is yet in its infancy, and it may have a brilliant future.

Comparative Cost of Water Power.

The cost of water power development in France, according to a French authority, varies from $21.40 per horse power to $150 per horse power, depending on the head to be dealt with, the lower figure being obtained with a fall of 450 feet at Haute-Savoie, the horse power being calculated at the turbine shaft. In Switzerland, at Geneva, for the first group of turbines erected, of 840 horse power, the capital cost amounted to $300 per effective horse power. The groups of turbines subsequently erected cost but $95 per horse power, making the completed works cost $135 per horse power. At the chlorate works at Vallorbes, Switzerland, the capital expenditure upon a development of 3000 horse power was only $19.45 per horse power.

As regards the rates charged, the cost of energy for power purposes from water power stations in France and Switzerland varies from 2.1 cents per unit for small powers to 1.24 cents per unit for large powers. At Niagara, the rates charged to ordinary consumers by the Cataract Power and Conduit Company varies from 2 cents per unit for 1000 units per month or less to 0.64 cent per unit for 80,000 to 200,000 units per month.

Bronzing Cast Iron.

Having thoroughly cleansed the surface and rubbed it down smooth, apply evenly a coat of vegetable oil, say, sweet or olive oil, and heat the iron object, being careful that the temperature does not rise high enough to burn the oil. At the moment of decomposition of the oil, the cast iron will absorb oxygen and this forms upon the surface a brown oxide skim or film, which takes a fast hold and is so hard that it will admit of a high polish, thus bestowing upon the iron a most striking resemblance to bronze.

Street Railway for China.

China may be a little belated in adopting electric traction, but now that the time for the innovation has come, the wily Chinese do not propose to give away the privilege for nothing. A project is under consideration for the construction of 23 miles of electric trolley lines in the streets of Shanghai, but the franchise stipulates a yearly rental of $500 per mile of single track and $750 per mile for double track.

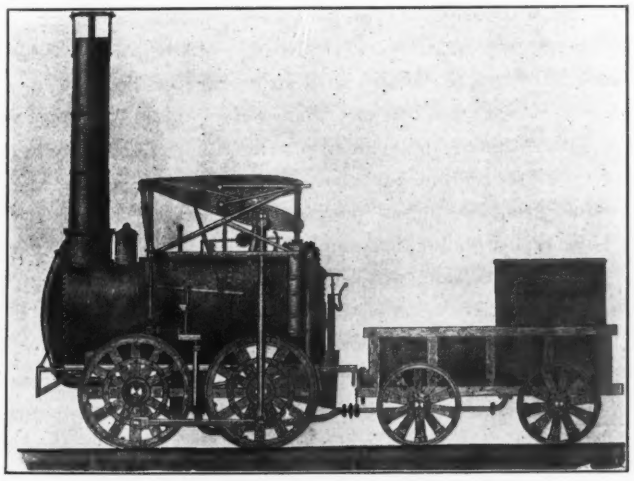
The First Locomotive that Ever Ran on a Railroad in the United States. Seventy-fifth Anniversary of the Event.

By courtesy of the Philadelphia *Press,* we are able to reproduce a photograph of the first engine that ever turned a wheel in the United States. It was run for the first time at Honesdale, Pa., on August 8, 1829, and the seventy-fifth anniversary of this important event was recently celebrated. The engineer who ran it was Horatio Allen.

While the history of railroading dates back to 1804, when in England Richard Trevithick was the first man to build a locomotive to run on rails, yet it was not until 1829 that the first practical locomotive, known as the "Stourbridge Lion," was run in the United States. This engine was imported from England and arrived in New York in May, 1829. The boiler was tubular and the exhaust steam was carried into the chimney by a pipe in front of the smoke stack, as shown in the accompanying illustration. It had vertical cylinders of thirty-six inch stroke, with overhead grasshopper beams and connecting rods.

The more famous engine known as "John Bull" and which is now in the National Museum at Washington, D. C., was not brought over from England and put into service until 1831. To prove that these early engines were not toys, during the Columbian Exposition in Chicago in 1893, "John Bull" made its way under its own steam from Washington, where it had long rested, to Chicago, drawing a train of two cars a distance of 912 miles without assistance. It further distinguished itself while there by carrying 50,000 passengers over exhibition tracks and although 62 years of age at the time, it showed itself quite capable of performing substantial work.

The first locomotive built in this country was the "Old Iron-



The "Stourbridge Lion"—the first Locomotive to turn a wheel in America.

sides," built by the Baldwin Locomotive Works in 1832. This engine ran for a number of years. It had four wheels and weighed a little over five tons. The drive wheels were 54 inches in diameter and the cylinder 9½ inches in diameter, 18 inches stroke. The wheels had heavy cast iron hubs with wooden spokes and rims and wrought iron tires, and the engine frame was of wood placed outside the wheels. The boiler was 30 inches in diameter and had 72 copper flues 1½ inches in diameter, 7 feet long. It attained a speed of 30 miles an hour with its train.

The growth of railroading can best be illustrated by the fact that in 1842, the Baldwin Locomotive Works turned out 14 locomotives in one year; now they can turn out, on an average, five locomotives a day or fifteen hundred in one year. This growth can be further illustrated by the statement that in 1852, the Pennsylvania Railroad moved 70,000 tons of freight in one year; now it moves 1,000,000 tons in one day, and where in 1829, one engineer was required to run and fire this solitary engine, there are now in 1904, 1,200,000 railroad employees on the pay rolls of the different companies in the United States. Certainly these seventy-five years represent a growth which is truly marvelous and this growth has been made possible only by the advancement of engineeering, such as bridging the Salt Lake in Utah, or tunnelling the Hudson river in New York, which even in these later days is astonishing.

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Ice-Making in India. Primitive Method of Producing the Frozen Product.

Dr. Wells, a London physician, in 1818, in his published essay on dew, was the first to draw attention to the curious artificial production of ice in India. Shallow pits are dug, which are partially filled with perfectly dry straw. On the straw, broad flat pans containing water are exposed to the clear sky. The water, being a powerful radiant, sends off its heat abundantly into space.

The heat thus lost cannot be replaced from the earth, for this source is excluded by the straw. Before sunrise a cake of ice is formed in each vessel. To produce this ice in quantities clear nights are advantageous, and particularly those on which practically no dew falls. Should the straw get wet it becomes more matted and compact, and consequently a better conductor of heat, for the vapor then acts as a screen over the pans, checks the cold and retards freezing.

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Hard-Soldering Fluid.

The composition known by this name consists of a solution of phosphoric acid in alcohol. It is prepared by dissolving phosphorus in nitric acid, evaporating the solution to eliminate the excess of nitric acid, and mixing the syrup mass with an equal quantity of alcohol. This fluid may be used for soldering copper as well as brass, bronze or German silver. Phosphate of ammonia and phosphate of soda can be used for soldering copper. A useful flux for hard soldering may be made by mixing quartz sand with pounded soda. The quartz sand consists of silicic acid; the soda, of carbonate of soda. When these two substances are mixed and then heated to a powerful cherry-red heat, they combine to form silicate of soda, and this compound will dissolve oxides if silicic acid is present in excess. With very high temperatures, such as are necessary to weld wrought iron, pure quartz sand is sufficient. If it is sprinkled on the glowing iron, and the second portion of the iron likewise in a glowing condition laid upon the first, both portions being then joined by means of vigorous hammering, the compound of the silicic acid with the iron oxides collecting on the surfaces of the metals will be pressed out into liquid form, and the iron surfaces, now thoroughly clean, will readily unite.

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In Memory of Robert Fulton.

While the patriotic associations are doing a valuable service in preserving Revolutionary relics and building monuments to the heroes of the Civil War, there is no association, except perhaps historical societies, to prevent the destruction of anything which recalls the story of great inventions and discovery. This fact is brought to mind by the announcement that the birthplace of Robert Fulton is about to be torn down unless bought from the owner. It is situated near Lancaster, Pa., and as the price asked for it is only a small sum, it ought to be practical to preserve this house in which the problem of the first successful steamboat was thought out.

There is a famous painting which illustrates the march of the conquerors in military strife, showing the great generals, such as Alexander the Great, Cæsar and Napoleon marching through the countless millions of dead bodies that lay in their wake. Why should not a picture of Watt, Fulton, Bell, Morse and the other noted inventors at the head of a host of the army of inventors that have gone before them, be equally impressive? Who has done the most for the progress of civilization, the hero or the inventor? Outside the scientific and engineering world, the names of the famous inventors have all but been forgotten.

Robert Fulton's place in history dates back to the year 1807, when he placed his steamboat the "Clermont" on the Hudson River. This marks the beginning of practical steam navigation and it preceded, by at least five years, the practical use of the steamboat in any other country, for it was not until 1812 that Henry Bell, of Scotland, built the "Comet," that plied on the Clyde and it was not until 1814 that a steam packet was used on the Thames in England.

There were steamboats of a very much more or less crude nature built before the one of Robert Fulton's but they are regarded as experiments only, and he was the first inventor whose labors in this line were not to be classed as an abandoned experiment. His boat was 133 feet long, 18 feet beam and 7 feet in depth. The engines were coupled to the crank shaft by a bell crank, and the paddle shaft was separated from the crank shaft, but connected to it by gearing. The cylinders were 24 inches in diameter and 4 foot stroke. The side paddle wheels had buckets 4 feet long with a dip of 2 feet. It made the first trip from Albany to New York, a distance of 150 miles, in 32 hours, and returned in 30 hours, it being the first voyage of any length ever made by steam power.

If this birthplace of Robert Fulton is saved from destruction, it will leave one footstep in the engineering path of time.

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Our Big Coal Output.

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of over $5,000,000 yearly. It is therefore the duty, which will become more strongly impressed as the years roll along, of everyone connected with a power plant to utilize the coal shoveled into the furnace so that the maximum output will be obtained.

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Whenever electricity is spoken of by a person who is unfamiliar with its laws and theory of action, or whenever a discussion arises between persons who are unfamiliar with its apparent mysteries, the remark: "What do you know about electricity? You cannot even tell me what it is!" usually ends the argument; and it must be admitted that even to a person well versed in all the branches of this industry, this question is unanswerable. Up to the present time, it is not known what electricity is.

The fact that we do not know what electricity is usually troubles us in the inverse ratio of our knowledge of it and the man who does not know a volt from an ampere worries more about it than one who is well acquainted with its laws and applications. As one looks about and sees the telegraph with its aerial gridiron of wires, the telephone, which makes the opposite ends of the earth almost neighbors, the wireless telegraph, that defies the boundary of space, the electric light, which turns night into day, the electric furnace, the electro-magnet, the electric dynamo and motor with its thousand and one applications, he begins to wonder what there is about electricity that is not known.

A schoolboy, fresh from college, with an air of contempt and awe, will tell you that "although electrification is a form of potential energy, electricity itself is not a form of energy at all; it is rather a form of matter, and that in its most refined sense. Like matter, it can neither be created nor destroyed but can be moved and put under stress. It acts like an incompressible fluid, filling all space, having a rigidity necessary to propagate the enormously rapid minute oscillatory disturbances, yet, at the same time, allowing the free motion through it of ordinary matter," or something like that, and when we have recovered, we are sure that we do not know what electricity is.

Before the discovery of electricity, the science of physics was divided into two branches—matter and energy—and what was not classed as belonging and following the laws pertaining to matter, was found to fit in with the laws of energy. The principal thing that is not known about electricity is, to which of these great divisions of the earth's laws does it belong? It is here that the great scientists differ. Some say that it is energy and some say that it is matter. Those that say it is matter are laughed at because, if it were matter, how could it penetrate such things as wood and aluminum, as does the X-ray, and if it were matter it would certainly have weight, and who has heard of an ounce of electricity? On the other hand, those that say electricity is energy are asked equally puzzling questions which have not yet been solved.

It suffices to say that while the others are fighting out this problem, the thing that the engineer is most interested in is not what it is, but what can it do, and how best make it do it. Fortunately, the laws of the electric current are as well known and as accurate as many of the older sciences and no doubt should be thrown upon the results of a calculation or the results of an experiment just because our big thinkers do not yet know upon what shelf in the universe this phenomena is to be placed.

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It is because of the uncertainty of results obtained that the steam turbine cannot be indicated in our present meaning of the word. It has been suggested that the indicated power of a turbine can be obtained by placing a series of pockets of thin brass, filled with mercury, along the length of the turbine, fitted with thermometers. This will give a series of readings at such points, which can be plotted as a curve of pressures by the aid of steam tables, if saturated steam is used. If superheated steam be used, a series of pressure gauges must be used to correspond to the thermometer readings at the same section. The rate of expansion can be found in this manner. When superheated steam is used, the difference of the reading of the thermometers and pressure gauges will show the extent to which the superheat is retained as the steam travels through the turbine. It is said of this method that a steady load renders such methods of investigation easy and reliable.

While this sounds all right, how would an engineer like to trade his little nickel-plated friend for a dozen thermometers and pressure gauges bristling around the cylinder? It has been the experience of most engineers that it is hard enough to keep the few gauges around a steam plant in the straight and narrow way of telling the truth and as for thermometers, they are known to break with very unpleasing regularity. With these difficulties in mind, it is generally stated that a steam turbine cannot be indicated, but if it is done by the above-mentioned method, its results can only be speculative, while a card taken from an indicator, if taken properly, represents as much the truth as the value of one of Uncle Sam's greenbacks.

The Practical Engineer

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L. L. RICE, Proprietor

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The Practical Engineer is devoted to the economical generation and utilization of power for the industries.

Articles upon subjects of interest to engineers, will always receive our very careful attention.

The little things are often most valuable, therefore, we especially solicit short articles on the small problems met with in daily practice. When illustrations are desirable a pencil sketch is sufficient.

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In Memory of Robert Fulton.

While the patriotic associations are doing a valuable service in preserving Revolutionary relics and building monuments to the heroes of the Civil War, there is no association, except perhaps historical societies, to prevent the destruction of anything which recalls the story of great inventions and discovery. This fact is brought to mind by the announcement that the birthplace of Robert Fulton is about to be torn down unless bought from the owner. It is situated near Lancaster, Pa., and as the price asked for it is only a small sum, it ought to be practical to preserve this house in which the problem of the first successful steamboat was thought out.

There is a famous painting which illustrates the march of the conquerors in military strife, showing the great generals, such as Alexander the Great, Cæsar and Napoleon marching through the countless millions of dead bodies that lay in their wake. Why should not a picture of Watt, Fulton, Bell, Morse and the other noted inventors at the head of a host of the army of inventors that have gone before them, be equally impressive? Who has done the most for the progress of civilization, the hero or the inventor? Outside the scientific and engineering world, the names of the famous inventors have all but been forgotten.

Robert Fulton's place in history dates back to the year 1807, when he placed his steamboat the "Clermont" on the Hudson River. This marks the beginning of practical steam navigation and it preceded, by at least five years, the practical use of the steamboat in any other country, for it was not until 1812 that Henry Bell, of Scotland, built the "Comet," that plied on the Clyde and it was not until 1814 that a steam packet was used on the Thames in England.

There were steamboats of a very much more or less crude nature built before the one of Robert Fulton's but they are regarded as experiments only, and he was the first inventor whose labors in this line were not to be classed as an abandoned experiment. His boat was 133 feet long, 18 feet beam and 7 feet in depth. The engines were coupled to the crank shaft by a bell crank, and the paddle shaft was separated from the crank shaft, but connected to it by gearing. The cylinders were 24 inches in diameter and 4 foot stroke. The side paddle wheels had buckets 4 feet long with a dip of 2 feet. It made the first trip from Albany to New York, a distance of 150 miles, in 32 hours, and returned in 30 hours, it being the first voyage of any length ever made by steam power.

If this birthplace of Robert Fulton is saved from destruction, it will leave one footstep in the engineering path of time.

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Central Station of the City of Jacksonville, Florida.

A Condensing Plant in Which Turbines are Used as Prime-Movers.

The rapid progress made in the rebuilding of the City of Jacksonville, made necessary the consideration of extensions to the City Electric plant to satisfactorily meet increasing demands for electric light and power. As the available space was limited and the cost of reciprocating engine foundations excessive, owing to the character of the soil, the merits of the steam turbine as a prime-mover were given careful consideration. It was finally decided to place two 300 H. P. DeLaval steam turbines direct connected to two 200 K. W. Bullock 3-phase, 2300 volt twin alternators designed for 7200 alternations per minute, two 350 H. P. Babcock & Wilcox boilers, Babcock & Wilcox boilers are operated under natural draught, a steel stack 100 feet high, 60 inches diameter being used. The boilers are connected to the main steam header which also connects to the old boiler plant. A working pressure of 200 lbs. is maintained and each boiler is equipped with a Babcock & Wilcox superheater, which produces steam superheated to about 100° F. when boilers are operated at their rating. The turbines are operated under these steam conditions and as will be noted, a high pressure and superheat combined are especially applicable for steam turbine service. Fig. 1 is a view of the turbines from the steam end. The old plant will be noted in the background. The small pipes leading to the end bearings of the turbines supply water to the water jackets. The high speed bearings are all lubricated from a central oil tank which feeds the manifold sight feed lubricator on each turbine. The

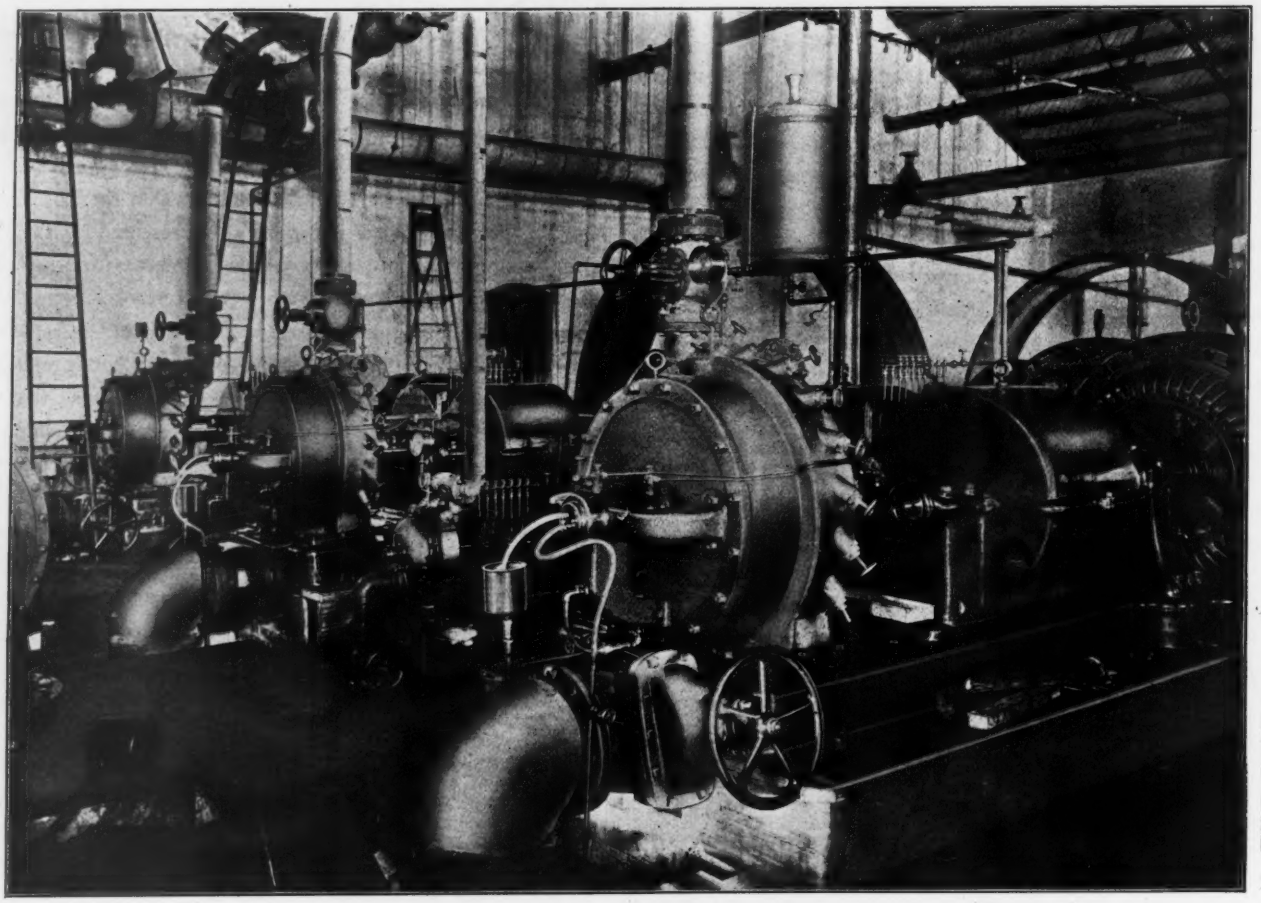


Fig. 1.—Interior of Jacksonville, Fla. Municipal Plant.

Alberger condenser and other necessary accessories. It was later decided to place an additional 300 H. P. DeLaval steam turbine direct connected to a 200 K. W. 500 volt, direct current generator. The entire contract was assumed and executed by the D'Olier Engineering Company, Phila.

The plant is located near the centre of the city, the lines extending about one mile north, one and one-half miles to the east, two miles to the southwest and one-half mile to the west. Alternating current is furnished for lighting and direct current is furnished over an area of about two square miles for elevator motors and other power service. The general layout of the additional plant installed is shown in Fig. 3. The two steam turbine exciter is situated between the two alternators. Fig. 2 shows the steam turbine pump used to supply the circulating water; also condenser and vacuum pump in the foreground and Fig. 3 shows a plan of the boiler and engine room.

It will be noted from the foregoing that steam turbines are used exclusively as prime-movers excepting for the vacuum pump. The Alberger condenser used is guaranteed capable of condensing 15,000 lbs. of steam per hour and to maintain a vacuum of 28" with a 30" barometer; and under these conditions the plant is operated on a most efficient basis.

The alternating current switchboard is constructed of Tennessee marble, consisting of three panels supported on angle

iron frame. Each generator panel is provided with three ammeters, voltmeter, rheostat, combined oil switch and circuit breaker and necessary synchronizing devices.

The plant as now completed consists of the following apparatus: Four Babcock & Wilcox boilers of 350 H. P. each and one Caldwell boiler of 350 H. P. One Filer-Stowell Cor-

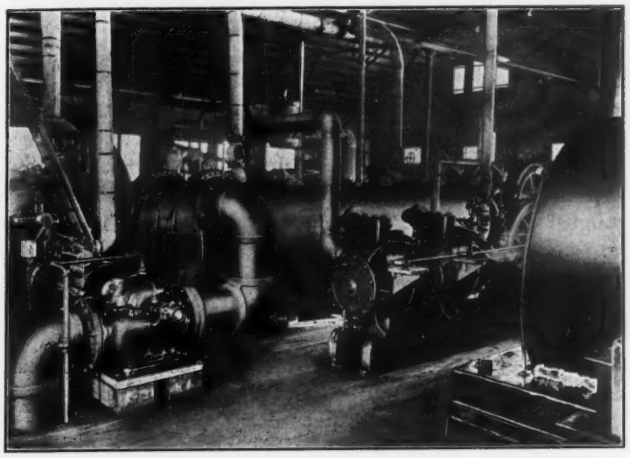


Fig. 2.—Steam Turbine Pump connected to Surface Condenser, Jacksonville Plant.

liss cross compound engine of 750 H. P., and two Hamilton Corliss tandem compound of 350 H. P. each; four General Electric Company monocylic generators, two of 150 and 200 K. W. respectively, and two 250 K. W. each; three No. 11 brush arc dynamos with a capacity each of 125 lights of 2000 C. P. One direct current 150 W. W., 500 volt generator; two 300 H. P., 200 K. W. DeLaval turbine alternating current generators and one 300 H. P., 200 K. W. DeLaval turbine direct current generator with condensers and auxiliaries.

The plant is owned by the City of Jacksonville and is under the supervision of the Board of Trustees for the water works and improvement bonds.

Cross-Exhaust Valves, Cushion Valves and Their Use.

By C. W. Dunlap.

I was called into a pumping station the other day to see what was wrong with a triple compound duplex piston direct pressure pumping engine. The engineer had reported to the foreman of the shop that he could not get the water-hammer out of the pump and he was afraid some harm might be done if we didn't send a man down to see what was wrong. On entering the engine room, I was soon aware that the pump was running, for every stroke the plungers would fetch up with a dull thud peculiar to this type of engine when it is not properly cushioned. I hastily reached for the cushion valves on the intermediate cylinder and found them wide open. I then tried the cushion valves on the low pressure cylinder and they were closed. I opened them gradually to see what effect they would take on the engine; but there was no change, the engine pounded just the same. Something had to be done and before long, or there would be some broken valves in the water end. So I asked the engineer if he could shut down for a short time, and he said he would; but that he would have to run a little longer that evening to fill the reservoir. The pumps were pumping water into a reservoir from a stream and the water flowed from the reservoir by gravitation to the consumers. The pumps were operated in the daytime only.

After shutting down the pump, I took off each cushion valve and examined it carefully, and apparently they were all right. I then examined the cross-exhaust valves and they were down tight, each one of them, there being two, one between the two intermediate cylinders, and one between the low pressure cylinders on the exhaust conductor pipes. I asked the engineer why they were closed, and he said that he couldn't see what good they were anyhow, and so he shut them up. I told him that they surely must be some good or the company that built the pump wouldn't have put them on. He couldn't see it. He said that as the steam was exhausted from the high to the intermediate and from the intermediate to the low he could not see why each side of the pump could not perform the duty with the steam admitted to the high pressure cylinder. I then explained to him, as best I could, that the cross-exhaust connections acted as an equalizer in a way, and also that as the steam leaving the high pressure cylinder would naturally have to work expansively in the next cylinders, and that steam after leaving the high pressure cylinder soon loses its power there, why not use it as soon as possible and get all the energy out of it?

For instance, if the steam from the high is exhausted into the conductor to the intermediate, a certain time elapses before it can perform its duty in the intermediate cylinder where the cylinders are connected in tandem, but with the cross-exhaust the instant the steam leaves the exhaust pipe from the high on one side, it can exert power on the piston of the intermediate on the other side, as that piston is traveling in the opposite direction to the former. The same conditions exist with the exhaust from the intermediate cylinders to the low pressure cylinders and the cross-exhaust valve performs the same duty. "Well," says the engineer, "if that is the case, we will have to take off the cross-exhaust piping and take out those blind flanges on the conductor pipes." They were soon taken off and

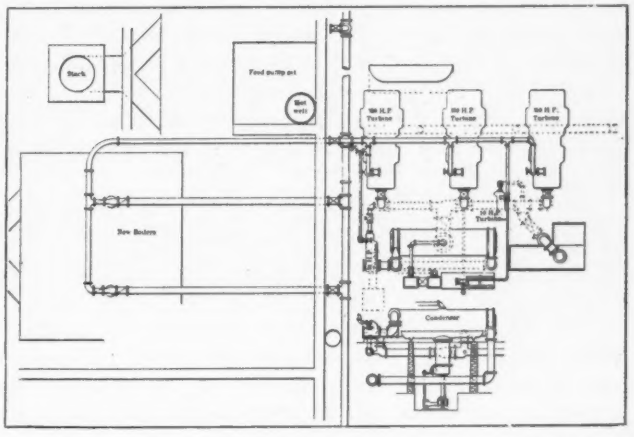


Fig. 3.—Plan of Boiler and Engine Room, Jacksonville Plant.

new gaskets made, the piping put back together, and, after warming up the joints and pulling them up again, we started up the pump. After a few strokes the engineer gradually increased the speed to the limit, which was 30 revolutions per minute, but the pounding was almost as bad until I arranged the intermediate cylinder cushion valves. I had to close them entirely, and regulate the cushion with the low pressure cush-

ion valves. In a short time all the pounding had ceased, that is, as much as could be expected of that type of engine, there being no fly-wheel. There is some jar at the end of each stroke that cannot be entirely taken out with the cushion valve.

After I had the pump working at what I thought was all right, the engineer asked me what I thought of the air-pump. He said that it stopped occasionally; so after examining it, I told him to give it some graphite occasionally in the cylinder, and as I was about to step away from the pump I put my hand on the discharge pipe and it was very cold. I then asked the engineer why he didn't warm that up a little and get better results. He did not seem to understand me, so I explained to him that if he would reduce the injection water supply, it would increase the temperature of the water in the hot well, and there would be a saving. I then explained that if he would reduce the vacuum, say from 28″ to 23½″ or 24″ and accordingly increase the temperature of the air-pump discharge from 55° F. to 102° F. he could make a saving in the fuel. I told him that he could try it, and if it was not a success he could return to the old method. He tried it and since has reported to me a saving in fuel each day. He says it requires his attention more than before, but so long as there is a saving, he is satisfied.

Starting and Stopping Boiler Tests.

By W. H. Wakeman.

Nearly every engineer has made, or desires to make, a boiler test, because he reads about those that are made from time to time for various purposes, and he naturally wishes to know if his plant gives as good results in practice as his neighbor reports.

It is claimed that the ordinary return tubular boiler evaporates about 7 pounds of water for each pound of coal burned under it, and as this is much below what is possible, an experiment made to show just what is done from day to day in a plant, then another one conducted to determine what can be done, constitutes an experience that is sure to result in some benefit to all concerned, and in many cases it will call attention to defects that are costing somebody good sound money every day, and at the same time suggest remedies for these faults, whether they consist of defects in the plant, or in the management of it.

While there is chance for error to creep in during every hour that is covered by a boiler test, there seems to be a much better chance at both the beginning and close of it, and to call attention to these possibilities is the object of this article.

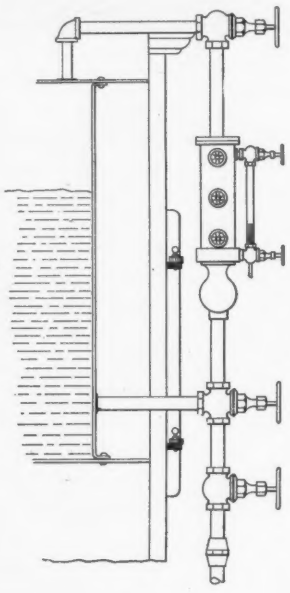
Take the case of a test made to determine the weight of water evaporated for each pound of coal burned. It is necessary to know whether water pumped into the boiler is evaporated, or only heated and then thrown out, for without this knowledge, a test is of no value.

Two other important things to know in this connection are the weight of coal used and of water disposed of. To weigh coal and water is not a difficult matter, but the chances for making mistakes when starting and stopping a test are overlooked in many cases.

There are two ways of accounting for the coal at these times, one of which is to note the amount of fire in a furnace when the test begins, also when it closes, the object being to have it the same in both cases. The other is to start with clean grates, and end in the same way.

Some time ago I saw a test conducted where the engineer in charge simply noted the amount of material in the furnace when the test began, without giving special attention to the condition of it. The fire was clean at this time, therefore an estimate of the thickness included good coal alone. At the close of test it was estimated that the material on the grate was of the same thickness, and calculations made which assumed that only the amount of coal shovelled in between the two periods mentioned was burned, but this was not absolutely correct, because the fire was dirty at the close, therefore a large part of what was in the furnace at that time was not good coal.

It is plain that more coal was burned than this trial accounted for, making the results unsatisfactory. There were 30 square feet of grate surface in this furnace, and we will assume that the fire was 9 inches thick, all good coal at the start, but at the close the ashes and clinkers were 3 inches thick, making 7½ cubic feet of refuse. If a ton of bituminous coal contains 45 cubic feet, then the difference above noted amounts



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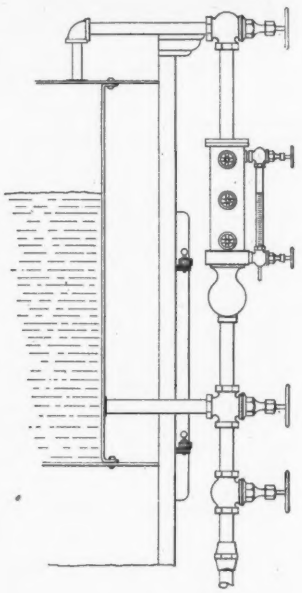


Fig. 2.

to one-sixth of a ton, or $2{,}240 \div 6 = 373$ pounds less than the weight actually burned.

If the test lasted for a week, this error would not amount to much, but where it covers 7 or 8 hours, it makes quite a difference in the results.

The remedy is to clean the fire just before closing the test, using enough good coal to make the fire as thick as when starting the test, which is only fair for all concerned.

It is customary in such a case to measure the thickness of material on the grate by the eye only, but if anybody can fix the amount at two different times and get it within 100 pounds, he can beat the writer, and is entitled to credit accordingly.

When the matter is first presented it appears as if starting with a clean grate and ending in the same way would remove all chance for error, but further consideration shows that there are several points to be considered.

If the furnace is comparatively cool and little or no pressure

on the boiler, it will take several hundred pounds of coal to raise steam to a working pressure. If this is charged to the test it is necessary to continue the fire until all coal is completely burned, after which all heat in the furnace must have a chance to pass into the boiler, or be dissipated into the air, in order to be fair, and this is not practical in a majority of cases.

To overcome this trouble, the following plan is recommended: Build a thin coal fire and raise steam on the boiler to the required working pressure. If there are two gauges of warm water and, say, 10 pounds of steam on when this fire is built, the necessary pressure may be secured before the furnace is thoroughly heated, therefore it may be well to have the water level down to one gauge, then run the injector until it is raised to 2½ gauges, or use some of the steam in order to give time for the furnace to be well heated.

If the boiler has been run during the night it is all the better, because all brick work will then be properly heated. When this condition is secured by either of the above methods, draw the fire and do not use this half burned coal during the test.

Select perfectly dry wood with which to kindle a new fire, weigh it, multiply the weight in pounds by .4 and call the product pounds of coal. No particular kind of wood is designated, which may not seem right to all readers, because some kinds are much more valuable than others, but all woods are practically alike when their weight is considered. Wood that gives out much heat when burning is heavy, while that which gives out less heat is lighter, and one condition practically balances the other.

Having weighed all coal and water used, as the time approaches for the completion of test, the fire should be burned as low as possible in order to utilize all heat generated. Having completed the test, clean the grates thoroughly, quenching the hot coal with water if there is not time to let it cool naturally. Of course, this wastes heat, but there is no practical way of preventing it.

Partially burned coal should be separated from ashes and clinker, and its weight subtracted from the weight of coal charged to the test.

When a test is begun, the height of water in the gauge glass must be carefully noted, also the conditions existing at that time in order that the same may be restored at the close of test. For illustration, suppose that the boiler is fitted with a water column in the usual way. After the drip valve has been closed for some time, water in the lower connection becomes cool, which means that it is heavier, consequently the height of water in the glass does not correspond to the water level in boiler. See Fig. 1.

If the drip valve is opened, allowing steam and water to rush through it, the whole becomes heated, making the water light again, hence when the drip valve is closed, water rises in the glass until it corresponds to the boiler water level. See Fig. 2.

There is no special reason why a water column should be either hot or cold when the water level is noted, but if it is cool at the beginning, it should also be cool at the end of test.

The necessity for this in each case may be tested by noting the height of water when the column is cool, then open the drip valve until both column and lower connection are well heated, close the valve and note the height of water again. In some cases it will be more than 3 inches higher when heated than when cold. If there is a variation of 2 inches it will make a difference of several pounds as follows:

With a heated column at the start of test, the gauge glass indicates a certain water level. Although the boiler water level may be the same at the close of test, if the column is cool the glass indicates, say, 2 inches less. If more is pumped in until the glass indicates the original level, there will be more in the boiler than there ought to be; or, in other words, the boiler will be given credit for doing more than it is justly entitled to. I suggest that the column be heated at both times, for by taking this precaution there will be no chance for error on this account.

A Twice Told Tale.

In our last issue, mention was made of the bursting of a steam pipe due to water hammer by the sudden turning of the valve on the steam pipe. The result was that the engineer was badly scalded, besides emptying the boiler of the water and injuring the adjacent dynamo. Just two weeks later, this accident was repeated. Another engineer, who took the place of the injured man, turned the same valve, at the same time in the morning, in the same way, with the same result. He was taken to the same hospital, badly scalded, and proper precautions will now be taken to see that the pipe is properly drained.

To Give a Black Color to Brass or Bronze Articles.

To provide such articles with a shiny gray or black coating, use is made of the property possessed by certain metallic salts of forming gray or black compounds with sulphur. The article is first plunged into a highly-diluted solution of sugar of lead, if the color is to be gray, or into a solution of blue vitriol, if a black color is desired. When dry, the article is placed in a diluted solution of hyposulphite of soda, which should be hot. In a short time, either gray sulphide of lead or bluish-black protosulphide of copper will be formed. If the solutions have been sufficiently diluted, the object will present a peculiar iridescent appearance, like that shown by soap bubbles, and due to the same causes. For it is a well-known physical fact that certain substances in extremely thin layers display the phenomenon of color known by the name of iridescence, and sulphide of lead and protosulphide of copper are among the substances possessing this property. If the process described is repeated in extremely diluted solutions, this iridescence passes over into a red, brownish or violet color. It is impossible to give absolutely definite directions for the production of these colors; success will depend entirely upon the skill of the operator.

Horse Power of Waterfalls.

The horse power of a waterfall can be obtained by measuring the width and depth of the stream a short distance above the falls. The product of these two factors gives the cross section and if this is multiplied by the velocity in feet per minute, it will give the number of cubic feet flowing per minute. Transfer this into pounds by multiplying by 62.5, the weight of a cubic foot of water, and multiply the product by the height in feet. Divide this product by 33,000 and the result will be the horse power of the waterfall.

LETTERS FROM ENGINEERS

IN ORDER to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories, and general engine-room experiences are especially solicited.

As Things Are Often Done.

EDITOR THE PRACTICAL ENGINEER:

In this and a number of the neighboring towns, the factories, as a rule, close for a few days during the first week in October to allow the employes a chance to attend the county fair. This is generally the last three days of the week. The manufacturers most always take advantage of this stop and have the boilers in their plant inspected. The engineers generally have quite a busy time during this stop.

There was at one time an engineer who had charge of a factory plant very close to where the writer is employed at present. This man used to have considerable trouble with the inspectors with regard to the condition of things under his boilers. He would never clean the dust and soot out of the combustion chamber or sweep the shells or walls off, making it a terribly disagreeable task for the inspectors. They used to complain to him about it, but he did not pay any attention. Finally, one inspector came to do the boilers and he refused to go under them until they were cleaned out, and went to the owner of the factory and stated the case. The boilers were soon put in proper condition so that the man could do his work.

There is no reason for an engineer being so stubborn in a case of this kind. He should have had those boilers in condition to allow the inspector every chance to detect any defect, in case there should be any, not to hinder him in every possible way, for it is as much to the interest of the engineer and his employer to know the real condition of the boilers as the company who issues the insurance policy. It is also a protection to those who are employed by this firm. The insurance company who hires this man holds him responsible for the boilers trusted to his care; if they did not, they could pick any one off the street to go and look at those boilers and say all right, but this will not do. Experienced men are employed who must work to the interest of their company. Any man who is careless on this particular point is just as much so on other things about his plant, and from what the writer has seen about this plant during the time this man had charge, he was decidedly so. He should take more interest about having his boilers in shape at boiler inspection; everything clean, so the inspector can see if there is anything wrong, instead of having to crawl through ashes and soot, choking and half blind with dust. How can any man make sure of anything in such a place? One thing sure, they are not supposed to clean the boilers, but the attendant is, so it is policy to perform the duties that belong to us.

An engineer with whom I was acquainted at one time used to have a peculiar way of cleaning his boilers, and getting them ready for inspection. The night before he would pump about two gallons of kerosene into each boiler, and then when the pressure was all off, he would run about half the water out of the boilers, leaving them about one-third full of water. Then he would take out the manhole plate on top and examine from the manhole the best he could. What was his idea for this way of doing? I never could learn. He did it this way just once too often. He was taking the manhole plate off and had set his light on the boiler about two feet away, and as he lifted the plate out there was in a very short time an explosion, and a great sheet of flame spread in all directions and the engineer was found on the floor terribly burned and unconscious. This man never was able to tell really how it did happen and to look at the poor fellow now, one cannot but pity him for he is in bad shape and will be for the rest of his life.

Any person who uses kerosene in their boilers should be careful how they use a light around the boilers.

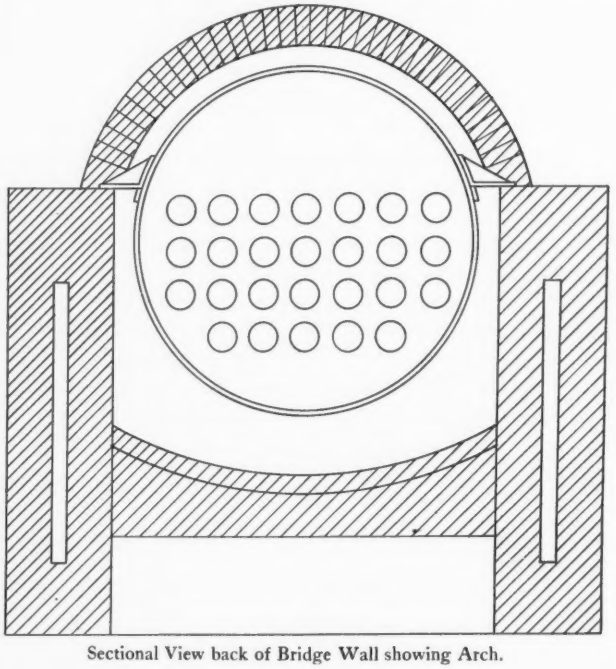
North Abington, Mass. A. T.

A Point in Boiler Setting Worthy of Note.

EDITOR THE PRACTICAL ENGINEER:

A point in boiler setting which is followed by the writer and which has proven to be of much benefit to the life of the boiler as well as the economical efficiency is described below.

In this setting, the boiler is arched over as shown by the accompanying sketch. The side walls are built up, keeping away from the shell of the boiler 4 inches and when the walls are a little above the centre line of the boiler, the arch is started



Sectional View back of Bridge Wall showing Arch.

and continued over the boiler, leaving a space of two to four inches between the arch and the boiler. This arch should be 8 inches in thickness and preferably should be cemented over to help preserve the brick work as well as make it as near as possible air-tight. Header rows should be built down to the boiler to prevent any draft through the space under the arch.

The benefits derived from this arch are as follows: It prevents condensation of steam within the boiler and superheats the steam to some extent. It maintains a practically uniform temperature throughout the boiler and prevents contraction strains. For instance, when a fire is started under a boiler which is not arched over as per sketch, it is necessary to apply sufficient heat to the bottom portion of the boiler and tubes to generate steam before the portion of the shell above the water line begins to increase in temperature, therefore the bottom portion of the shell and tubes expand before the top portion, and as a result, the boiler is thrown into a strain and the tubes are apt to become disintact as well as distress of the longitudinal seams.

With this arch, the heat surrounds the boiler as the fire is started and the shell is heated more uniformly. There is also no trouble in maintaining practically air-tight walls as the expansion and contraction of the boiler do not affect the walls.

I am pleased to testify for this setting in one case in which a 60" x 16" boiler of the comemrcial class rated at 80 H. P. was in constant use for 15 years and by means of a mechanical draft was worked to a load of 115 to 130 horse power continually. During the 15 years no repair was made on this boiler except that one rivet was replaced, which defect was due to the use of the drift pin when the boiler was being built. When this boiler was removed to be replaced by a larger one there were no signs of pitting or corrosion of the shell and from all visible appearance the boiler was in first-class shape.

I consider that the good service of the boiler was due to the arching over and to good care.

Princeton, Ind. C. B. R.

Opening and Closing Valves.

EDITOR THE PRACTICAL ENGINEER:

The trouble with "A. T.," who writes about valves, is that he condemns without qualifications, the practice of using a wrench to open or close a valve, when there are many cases in which it is perfectly right and proper.

Theoretically it seems very nice to have all valves in a plant open and close easily, but practically it cannot always be done.

I have several times as many valves in my plant as he mentions in the August issue, and nearly all of them work easily, but some of them do not, hence it is more sensible to secure a reasonable leverage by using a wrench, then use it with good judgment, than to adopt a plan in which main strength and awkwardness are the chief factors.

Machinery in my charge is probably kept in as good repair as in any other plant, but I have not yet reached a condition in which my conscience will allow me to spend $50 of my employer's money in taking out a valve and putting in another simply because it cannot be closed tight by taking hold of its wheel (which may or may not be large enough to give a respectable purchase), when the conservative use of a small wrench will prevent it from leaking steam or water.

Furthermore, I do not hesitate to state that I sometimes use a wrench for this purpose.

An assistant engineer in a plant about two miles from mine could not close a small valve tight, so he took a wrench and twisted off the valve stem because he did not use common sense. Soon afterward he tried to close a similar valve near the first one mentioned, but it leaked also. He put a wrench on it and twisted off its stem in precisely the same way, so they looked alike.

While I was well aware of these facts when writing my original letter on this subject in the July issue, also of others along the same line, that does not prevent me from claiming that when "A. T." condemns without qualification the use of a wrench on a valve stem he makes a mistake.

Every engineer whose experience is equal to that of the writer in operating steam plants, and acting as a consulting steam engineer, has probably found himself so situated that more purchase was required on a valve stem than could be secured by grasping the wheel, and a wrench is nearly always the most convenient method for securing the extra leverage, without causing the least damage to anything.

New Haven, Conn. W. H. WAKEMAN.

The Engineers We've Had.

No. 4.—THE RECEPTIVE ENGINEER.

Although I oughtn't say it, I am glad that Jim got fired,
For with his grand pretensions, he always made me tired.
And you couldn't tell him anything—he'd always make you mad
By saying that he knew it all before you were a lad.
But the engineer we have now, is so different from Jim,
That it makes us all feel happy, and we like to work for him.
And he does what Jim used always think no engineer should do—
He talks to us and asks us if we've found out aught that's new.

He'll tell us all his plans for work, and all his doubts and fears,
And talk to us poor firemen just as if we're engineers.
And when we chance to see a plan to help him in a job,
The way he thanks us for it then, sets all our hearts athrob.
And he loses nothin' by it, for we often help him out
By doing little things for him when he is not about.
There are, sometimes, little favors that a fireman can perform,
When he's working for an engineer whose heart is true and warm.

And the boss can see the diff'rence, in the saving of the coal,
For the first day that the engineer came down into "the hole"
He just sat down an asked us if we knew of any plan
Whereby we'd save on coal and make it better for th' old man.
Of course, we knew a "kink" or two, but never told old Jim,
Because he thought no other man could be compared with him.
But now,—we told our plans, and got the credit for them all,
And the engineer ne'er said a word about himself at all.

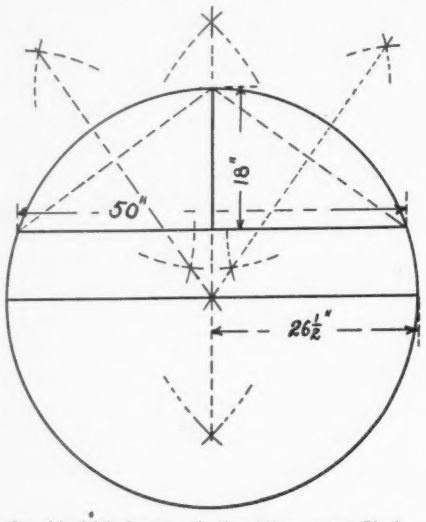
But that the boss knows he's all right is proven by the smile
Which comes upon his face, when he comes round each little while.
And that he likes the engineer, we knew the other day,
For he brought the same inspector in, and when he went away
Another letter from the boss was handed unto him,
And this is what he read to us: "Things looked so neat and trim,
The inspector said you are all right, and therefore from this day
You and your firemen, we believe, are worthy of more pay."

Another Method for Finding Diameter of Circle.

EDITOR THE PRACTICAL ENGINEER:

In reply to query of D. T. D., Kansas City, Mo., in the July issue of the "Practical Engineer," the same can be solved as a simple geometrical problem as follows:

Base, 50 inches, height, 18 inches laid off to scale of 1-16 inch, will make the base 3⅛ inches and height 1⅛ inches, which should be laid off as per accompanying sketch. Bisect quadrant, which gives the centre and radius, draw in the diameter and by scaling same with 1-16-inch scale, the solution is found.



Graphical Method for finding Diameter of Circle.

In case of a problem of this kind being required, as it is usually shown on paper, it is probably easier and more convenient to do it this way, as the centre of the circle and radius are found directly by the construction, it being unnecessary to take the radius from the scale.

El Paso, Texas. E. L.

Stationary versus Steamboat Firemen.

EDITOR THE PRACTICAL ENGINEER:

The argument in favor of the stationary fireman in comparison with the steamboat fireman, which has excited considerable discussion among educated engineers, has resulted in the majority being in favor of the stationary engineer, because the marine fireman is supposed to know nothing but shovel coal and boast over it. This is about all they are capable of doing, but they should not be condemned for that, but should receive some sympathy, because their associations are not advantageous for the gaining of knowledge; so, therefore, they have no authority for knowing they are right in what little they do think is right, but when they procure a job "on shore," where they have a chance of coming in contact with practical and theoretical mechanics, then if they do not take advantage of all their "experience at sea," I should readily disqualify them.

I once knew of one steamboat fireman who somehow procured a license to run a 50 H. P. engine "on shore." His time was taken up so much in the fireroom trying to keep up steam that he had little time to see the engine room, which was probably all the better for the engine. He usually ran it with the drips wide open because he claimed he did not want to take any chances of water getting in the eccentric. He also left valves open continuously where steam was used only a short time each day which he said was too much bother to go to the trouble of closing each day. So to avoid that extra trouble, he simply left them open to save himself work. Such extravagant ignorance is beyond comprehension.

In general, employers are ignorant of the necessary knowledge that the fireman should be endowed with. They often prefer some cheap steamboat man who is entirely lacking of all science involved in the economical consumption of coal, but who is a thorough coal waster or coal eater. Employers are apt to take the advice of anyone but their engineer in employing firemen, but sooner or later they discover that the stationary fireman, trained to scientific firing, is the most economical, even if he pays a little more salary to such a man. In my experience, in tests of endurance, I have found the steamboat fireman with me in hard jobs would last only from one to four hours and I could unmistakably tell in ninety-nine cases out of one hundred what they could do.

Brooklyn, N. Y. J. G. S.

Rodney's Troubles.
Or Do We Need a License Law in Michigan?

(Eleventh Letter.)

Mistur editur i got ure lettur yesteday and i tuk mi steem gaig down to rossens tin shop and had it soddered and it wurks aul rite now but i got intu sum moar trubbel a short time a go. sum buddy hez told henry that u kant see steem. henry sez that the fellar in the power hous told him thet steem wus a thin elastik flooid and u kant see it either. now i allus thot that elastik was sumthen fur suspenders or galloses, sumthen maid out ov rubber, but it dont seem so ef it is in steem duz it. anuther thing mi father allus tot me that kerryseen wus a flooid, he sed it wus a dangrous flooid, onli yesteday i askd him tu tell me sum differnt kinds ov flooids and he sed, whiskee, kerryseen, cider, wattur, vinniger, beer, and milk. now mistur editur, it dont seem az tho enny ov them is like steem duz it. but i supoze the new fangled names differnt things iz taken on, iz whut keeps a poor fellar in the dark. now how kin the steem be thin, fur jist the minut it gits out ov a pipe it spreads aul ovur evry whear, ef it can do that how can it be thin. i allus thot enny thing that was thin was like paper or cloth, fur haint u often herd about sumthen as thin as tishew paper. i think mebby thet henry didnt understand the fellar rite or mebby the feller wuz tryen to thro henry of ov his gard, noen az he did thet i had a applekashun in thear fur a job. but u will tell me theze things and when i git a chanst ile jist sho sum ov them power hous fellars a thing or 2.

well i got the biler fired up 1 day las week and hed i gess 40 pounds shoen on the gaige and i thot i wood try and pruve wether henry wuz rite about if i kud see steem, so i opend a valv on the biler and the steem cum out like a kloud, sumtimes in spray and sumtimes blue like. well when it wus kummin out like spray i just put mi hand up in it and it giv me a very bad burn so the more i think ov it the more i think steem can be seen and felt at the saim time. it wuz a lukky thing twas mi left hand thet i felt the steem with or i kuddent rite to you tu day fur i have to have flax seed meel poltises

put on mi hand evry day. there wuz anuther thing, tu, that maid me try the steem and see ef it wood burn me and that wuz henry sed thet steem wus a gas. now i dont beleeve any thing ov the kind fur the only gas around hear wuz from old man warfels well and they uzed it tu lite the villidge streets with afore they put the lecktrick lites in, and that gas woodent burn yure hands ef yude hold em on the pipe with the valv open. ov coars the gas wood burn ef yude tuch a match tu it, but no uther way. now i want u tu straten me out in these matturs and this faul ile ship u a bushel of rutte beggars and sum popcorn.

rodney gumkirk
orkners corners munrow kounty.
care my dad. Mishegan
speshal a liverry.

Extracting Boiler Tubes.

EDITOR THE PRACTICAL ENGINEER:

As I often hear discussions as to the best methods of removing old worn out boiler tubes from the tube sheet of boilers, I will give a method which I think is a good one.

Take a flat chisel as shown in Fig. 1 and use it to rip the tube inside of the tube sheet, holding the tool as near an angle of forty-five degrees as possible. Then with another chisel cut off the bead all around the tube so that the tube and sheet will

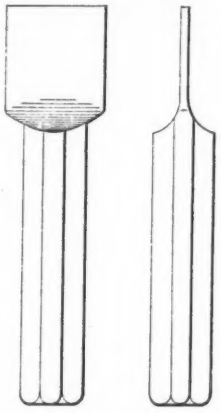


Fig. 1.

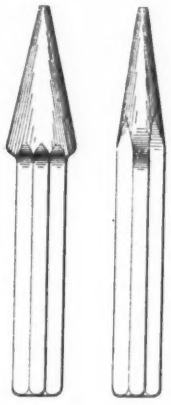


Fig. 2.

be flush. After the tube has thus been split and flushed, take an oval tool shaped like that shown in Fig. 2, and drive it between the tube and sheet, first where the tube is ripped and then on the sides. This will decrease the diameter so that it can be easily withdrawn from the tube sheet and it will not injure the sheet in the least.

Denver, Col. M. G. T.

Lost Hand While Cleaning Commutator.

While polishing the commutator of a dynamo, Frederick Young, an engineer at the Baldwin Locomotive Works, met with an accident that resulted in the loss of his hand. Young was cleaning the commutator of the dynamo with a piece of sand paper when the accident occurred. The current was turned off the machine but his hand was caught between the brushes and the commutator, which so terribly crushed and mangled it that it had to be amputated.

QUESTIONS and ANSWERS

THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers and questions, he especially desires the readers in such cases to contribute any further information, in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communication.

EDITOR THE PRACTICAL ENGINEER:

If I have to get new rings for the piston of my engine, which is a 12 x 16 slide valve engine running at 160 revolutions per minute at 90 pounds steam pressure, about how much should I leave the sawed ends apart for expansion in fitting them in the cylinder?

Milwaukee, Wis. E. B.

When piston rings are made of the snap design, they are turned as a solid ring to fit a diameter larger than the bore of the cylinder, usually about a quarter of an inch for every foot in diameter. The finished ring is then cut apart and sufficient metal taken out to permit it to be squeezed together so as to enter the cylinder. It will tend to expand to its original diameter against the bore and this pressure makes a steam tight joint. To keep the radial pressure against the bore the same at every point, the thickness of the ring should be graduated and should be the thinnest at the joint and the thickest opposite the joint.—[Ed.]

EDITOR THE PRACTICAL ENGINEER:

Please give the cause and remedy, if possible, of the pitting in boilers running under a pressure of from one to ten pounds. I have charge of two 52 H. P. horizontal tubular boilers and the way they rust and pit is something terrible. I am on the "dead end" of the water main; that is, there are no houses or is anybody using the water on one side of the building that I have charge of and nobody for a long way on the other. Now, as I have to feed water to the boilers only once in a long while, and as the plant is a low-pressure gravity system, the water being simply condensed over and over again, I can't account for the rusting. Please give me your opinion as to what course to pursue.

New York, N. Y. G. R. E.

Pitting in a boiler is due to some chemical action between the water and the boiler plates. Any acid that is in the water will pick out the most susceptible portions of the plate, which will cause the pitting referred to. The corrosion or rusting is also due to the chemical action of the feed water introduced into the boiler. As to the means to be employed for preventing internal corrosion or pitting, the surest is obviously to abandon the use of water, which has a corrosive effect upon the plates, but when this cannot be done, the simplest method of preventing the corrosion caused by a majority of waters is to neutralize the acidity by treatment with some alkaline substance, either before or after the introduction of the water

into the boiler. This is best done by using soda, soda ash or caustic soda. The quantity and materials required will depend entirely upon the water, and can only be determined by the analysis of the water, which can best be done by a number of well-known firms who make a specialty of these cases.

When comparatively pure water is found to act injuriously on the plates, such as is perhaps the case in this plant, where the water is used over and over again, corrosion may sometimes be prevented by allowing a small amount of impure water to enter the water sufficiently to deposit a thin layer of scale, which will protect the plates against the action of the more pure water.—[Ed.]

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EDITOR THE PRACTICAL ENGINEER:

(1). Will you please inform me how many horse power a boiler contains that is 48 inches in diameter and 18 feet long and has 12 6-inch tubes? The grate surface is 5 feet long and 5 feet wide.

(2). I would also like to know how many square feet of heating surface and grate surface are required per horse power?

(3). How large would the safety valve have to be to compare with the horse power of the boiler, and show how to reckon it.

North Menomonie, Wis. C. S.

(1). The only exact method for finding the amount of horse power that a given boiler will generate is to make a test of the amount of water that it will evaporate. If calculated from the dimensions it can be done by finding the amount of heating surface in the boiler and dividing by the number of square feet equivalent to one horse power as follows:

The heating surface of a horizontal tubular boiler is assumed to consist of two-thirds of the circumference of the shell, two-thirds of both end sheets, less the area of the flues, and all of the interior of the tubes or flues, as being exposed to the fire or combustion gases and therefore, effective as heating surface. From the above data then, we get for the different quantities:

Shell .....2-3 × 18 × 3.1416 × (48 ÷ 12) = 150.79
Heads .2 × 2-3 × (0.7854 × 48 × 48 ÷ 144) = 16.75
Tubes .....12 × 18 × 3.1416 × 6 ÷ 12 = 339.29

Total = 506.83
Less area of tube holes = 2.35

Total heating surface = 504.48

Allowing 12 square feet of heating surface per horse power, this will give, by dividing the total heating surface by 12, 42.04 horse power.

(2). The number of square feet of heating surface required per horse power varies with the kind of boiler, the condition of the draft and the kind of fuel used. An approximate rating allows 10 to 12 square feet of heating surface for one horse power, for a water tube boiler; 14 to 18 square feet for a tubular boiler; 8 to 12 square feet for a flue boiler; 6 to 10 square feet for a plain cylindrical boiler; 12 to 16 square feet for a locomotive boiler and 15 to 20 square feet for a vertical boiler.

The amount of grate surface required per horse power is equally as variable and also depends upon the character of the coal and upon the kind of draft. The square feet of grate surface required per horse power may vary from ¼ to one square foot, depending upon the above-mentioned conditions.

(3). The United States regulations for steam-vessels require that lever safety valves shall have an area of not less than 1 square inch to every 2 square feet of grate surface in the boiler. The Philadelphia regulations for fixing the size of safety valves take the pressure into account, and order that the least aggregate of the two safety valves required by law (being the least sectional area for the discharge of steam) to be placed upon all stationary boilers with natural draught may be expressed by the formula

$$A = \frac{22.5G}{P + 8.62}$$

in which A is the area of combined safety valves in inches; G is the area of the grate in square feet; P is the pressure of steam in pounds per square inch to be carried in the boiler above the atmosphere.—[Ed.]

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EDITOR THE PRACTICAL ENGINEER:

Will you kindly answer the following questions?

(1). What pressure does a column of water 100 feet high exert per square inch?

(2). What pressure does a column of air of infinite height exert per square inch?

(3). What advantage is an air chamber when placed above the valves, and what advantage when placed below the valves?

(4). How is an evaporative test of a boiler made?

New York, N. Y. W. G.

(1). As the pressure exerted by a column of water having one foot head is 0.434 pounds per square inch, the pressure exerted by a column 100 feet high is 43.4 pounds per square inch.

(2). A column of air of infinite height, if there was such a thing, would exert an infinite pressure per square inch. As the air only extends for some miles above the earth, its pressure is about 14.7 pounds per square inch.

(3). The duty of an air chamber when connected to a pump is to so use the elasticity of the air confined in it that it renders the pressure and flow in the pipes practically uniform, notwithstanding the intermittent action of the force, besides preventing the hammer blow which is caused by the sudden stoppage of a stream of water and which would be very injurious and disagreeable without the air chamber. Most makers put the air chamber on the delivery pipe above the valves, usually for ease of construction.

(4). The answer to this question is quite a long story and many engineers differ in details as to just how it should be done. For this reason, the American Society of Mechanical Engineers, after much investigation, adopted a method which is now generally adhered to. Some of the important features of their method are given below, so that an intelligent test may be made.

Before starting on a test, one should have the specific object of the trial in view, and each step should be carefully arranged beforehand with reference to it. The following rules covering the preliminaries of a test will be found useful for reference, and will assist the engineer in preparing for any special investigations:

1. Measure and record the dimensions and position of the grate and heating surfaces, flues and chimneys, proportion of air space in the grates, kind of draft, etc.

2. Put the boiler in good condition by having all heating surfaces clean, with grates and furnace walls free from clinkers. See that all smoke passages are free from obstruction, and that all leaks in the masonry are closed.

3. The coal should be dry, or if wet, a sample must be carefully dried and a determination of the amount of moisture made, so that the final results can be properly corrected. If the test is for establishing the efficiency of the boiler, it should be made, if possible, with some standard coal of known quality, and in all important tests a sample of the coal should be selected for analysis.

4. All apparatus, such as scales, tanks or measures, water meters, thermometers, gauges, etc., should be checked and compared with standards, if possible.

5. Before beginning a test, the boiler and chimney should be heated to their usual working temperature. If the setting is new, the boiler should be in continuous use for at least a week before testing.

6. See that the boiler and all connections are free from leaks. All water connections, including the blow-off and extra feed pipes, should be disconnected or stopped with blank flanges, except the pipe through which the boiler is to be fed during the trial.

If an injector is used, it must receive steam directly from the boiler being tested, and not from the steam pipe of any other boiler. The steam pipe should be arranged so that the condensation cannot run back into the boiler. If the connections are such that this will naturally happen, drip connections should be made and the water trapped and weighed. A test to be of value should last at least ten hours, and twenty-four is much better for important work. The conditions of the boiler and furnace in all respects should be as nearly as possible the same at the beginning and end of the test; the steam pressure and water level should be the same, and the fire upon the grates should be the same in quantity and condition.

There are two common methods of starting and stopping a test, known as the "standard" and "alternate" methods. In the first method steam is raised to the working pressure, and the fires are quickly drawn, the damper closed and all refuse removed from the ash-pit. A new fire is started at once with a known weight of wood and coal. At the end of the test the fires are again drawn and the ash-pit cleaned. The water level should be as nearly as possible the same at the end of the test as at the beginning. It will usually be necessary to regulate the flow of steam from the boiler by means of the stop valve for a time, while the fires are being drawn at the beginning and end of the test, in order to keep the steam pressure in the boiler up to the average during the test.

The alternate method is as follows: At the regular time for cleaning the fires, have them burned rather low, then thoroughly clean and note the amount of coal left on the grate as closely as possible; then take the steam pressure and the height of water in the gauge glass, and the time of starting the test. Fresh coal, which has been weighed, should then be fired and the ash-pit thoroughly cleaned. Before the end of the test the fires should be burned low, just as before the start, and cleaned in such a manner as to leave the same amount of fire and in the same condition as at the start. The water level and steam pressure should be brought to the same point as at the beginning, and the time of ending the test should be noted just before fresh coal is fired.

During the test, the boiler should be run continuously without stopping for meal-times or for rise or fall of pressure due to the change in demand for steam. The draft should be adjusted as nearly as possible to give the desired rate of combustion, and should be kept practically constant during the test by means of the damper. If the boiler is not connected to the same main with other boilers, an extra steam outlet with a valve should be provided, so that the pressure may be reduced if it runs too high, without checking the fires.

If the boiler is one of a battery and is connected to a common main, the safety valve on the boiler being tested should be set a few pounds higher than those on the other boilers, so that in case of a rise in pressure, the other boilers may blow off and the pressure be reduced by closing their dampers, allowing the damper of the boiler being tested to remain open, while the firing is carried on without change. All the conditions should be kept as nearly uniform as possible, such as force of draft, steam pressure and height of water level. The time of cleaning the fires will depend upon the character of the fuel, the rate of combustion and the type of grate used. When a good quality of coal is used and the combustion is not too rapid, a ten-hour test may be made without cleaning, except at the beginning and end of the test. If the quality of coal is such that cleaning becomes necessary, it should be done at regular intervals.

The coal should be weighed and delivered to the fireman in equal portions, each sufficient for about an hour's run, and a fresh portion should not be delivered until the previous one has been used. The time required for burning each portion should be recorded by noting the time of the first firing of each new portion. At the same time the amount of water fed into the boiler should be carefully recorded, also the height of the water line and the steam pressure, and the temperature of the feed. By keeping the records in this way, the test may be divided into sections if desired. For ordinary tests, such as the engineer of a plant would be apt to carry on, this is not necessary, as the totals for the entire run will be sufficient.

In order to make the necessary computations relating to a test, the following must be known: First, the weight of coal burned and amount of ashes left; secondly, the weight of water fed into the boiler; thirdly, the steam pressure carried; fourthly, the temperature of the feed-water as it enters the boiler; fifthly, the quality of the steam discharged from the boiler.

There are various ways of determining the amount of feed-water used. The best method is to weigh it in barrels upon accurate scales. Two or more barrels should be used, and of such size that the filling and weighing need not be hurried. They should be placed high enough to discharge into the tank or barrel from which the boiler is fed. The barrels should be numbered and the weight of each when empty should be recorded and deducted from the weight when full. When the water level in the feed tank has fallen so that it will hold another barrel of water, one of the barrels which has been filled and weighed should be emptied into it while another is being filled. At the beginning of the test the water level in the feed tank should be marked, and at the end should be brought to the same level. The level in the gauge glass of the boiler should be noted in the same manner. The temperature of the feed-water should be taken at regular intervals, so that an average may be taken at the end of the test.

The coal should be weighed in barrows or barrels, and fired directly from the barrows or barrels, or it may be dumped upon the floor before firing. The barrows should be weighed and their weight subtracted each time. Any unburned coal at the end of the test must be weighed and the amount subtracted from the total. The condition of the fire should be the same at the beginning and end of the test. For a long test of twenty-four hours or more it may be estimated by the eye; if the test is short, the standard method may be used if it is desired to be more accurate. If this method is employed, the fire should be allowed to burn low and the pressure be kept up by reducing the amount of steam taken from the boiler. About half an hour before beginning the test, the fire is drawn and a new one started with wood. When coal is first thrown on, the test is started. Toward the end the fire is again burned low and at the end is drawn out and quenched with as little water as possible. The unburned coal is picked out and its weight subtracted from the coal fed into the furnace. The clinkers and ashes are separated and weighed with the clinkers and ashes formed during the test. The wood used is weighed and considered as equal to 0.4 the same weight of coal.

The temperature of the feed-water is best taken by means of a thermometer in a cup filled with oil and screwed into the feed pipe near the check valve. If the temperature is nearly constant, readings may be taken once in fifteen minutes; if it varies much, the readings should be taken oftener. The steam pressure should be kept as nearly constant as possible, and should be practically the same at the beginning and end of the test. Readings should be taken in the same manner as above described for the temperature of the feed-water. The quality of the steam may be obtained by means of a throttling separator or barrel calorimeter, the first two being preferable on the score of accuracy.

In making complete tests, samples of flue gas are taken from the chimney uptake and back of the bridge wall. The object of this is to determine whether the proper amount of air is admitted to secure complete combustion. The chimney draft is usually obtained by means of a U tube partially filled with water. A rubber tube is attached to one leg of the tube and is inserted into the chimney through a small hole drilled for this purpose. A difference of ¼ in. in the water level in the two legs indicates a moderate draft; ⅜ to ½ in., a moderately strong draft, and ¾ to 1 in., very strong. As the chances of error in making a boiler test are so great, care and accuracy must be used throughout, both during the test and in working up the data.

In order to make comparisons of the efficiencies of boilers working under different conditions of steam pressure and temperature of feed-water, it becomes necessary to reduce the working conditions to a common standard. The standard adopted is called "equivalent evaporation from and at 212 degrees," which means in any given case that the heat required to change a certain quantity of feed-water at a given temperature into steam at boiler pressure, would evaporate a different and definite quantity of water from a temperature of 212 degrees into steam at atmospheric pressure. For example, a boiler carrying a pressure of 90 pounds gauge, and supplied with feed-water at a temperature of 60 degrees evaporates 3000 pounds of water into steam per hour. What is its equivalent evaporation from and at 212 degrees?

From a steam table we find that the temperature of steam at 90 pounds pressure is 331 degrees, and the "heat of vaporization" is 880 thermal units; then for one pound of water the "heat in liquid" above the temperature of the feed-water is $331 - 60 = 271$ thermal units, and the "total heat" is $271 + 880 = 1151$ thermal units; therefore, the heat required to raise the temperature of 3000 pounds of water from 60 degrees and evaporate it into steam at 90 pounds pressure is $1151 \times 3000 = 3{,}453{,}000$ thermal units. Looking in the table again we find the "heat of vaporization" for steam at atmospheric pressure to be 966; therefore, $3{,}453{,}000 \div 966 = 3574$ pounds, the equivalent evaporation from and at 212 degrees. The ratio, $3574 \div 3000 = 1.19$ is called the "factor of evaporation" for the conditions given in the problem. Engineers' handbooks and many boiler catalogues contain tables giving the factors of evaporation for varying combinations of feed-water temperature and steam pressure.

The method of recording the results of a test and making the necessary computations may be shown by the results of an actual test upon a 250 horse power water-tube boiler.

DATA.

1. Heating surface—2552 sq. ft.
2. Grate surface—57 sq. ft.
3. Ratio of grate to heating surface—1 to 44.7.
4. Kind of fuel—Cumberland.
5. Rated horse power—250.

FROM OBSERVATION.

6. Steam pressure (average)—125 lbs. (gauge).
7. Chimney draft—.11 in. of water.
8. Temperature of feed-water—210 degrees.
9. Pounds of coal burned—5713.
10. Pounds of refuse—490.
11. Pounds of water fed to boiler—60,217.
12. Quality of steam from calorimeter—99.94 per cent.

COMPUTED.

13. Pounds of combustible—$5713 - 490 = 5223$.
14. Proportion of refuse—$490 \div 5713 = .86$, or 8.6 per cent.
15. Coal burned per hour—$5223 \div 8\frac{1}{2} = 672$ lbs.
16. Coal burned per square foot of grate per hour—$672 \div 57 = 11.78$ lbs.
17. Total water evaporated—$60{,}217 \times 99.94 = 60{,}181$ lbs.
18. Water actually evaporated per pound of coal—$60{,}181 \div 5713 = 10.54$ lbs.
19. Water actually evaporated per pound of combustible—$60{,}181 \div 5223 = 11.5$ lbs.
20. Water actually evaporated per pound of coal from and at 212 degrees— $\dfrac{60{,}181 \times 1046}{5731} = 11.01$ lbs.
21. Water actually evaporated per pound of combustible from and at 212 degrees— $\dfrac{60{,}181 \times 1046}{5223} = 12.05$ lbs.
22. Horse power developed during test— $\dfrac{60{,}181}{8.5 \times 34.5} = 205.$
23. Efficiency of boiler—Assuming each pound of coal of this grade to contain 13,000 thermal units, the total heat given up by the coal is $5713 \times 13{,}000 = 74{,}269{,}000$ thermal units. The total heat utilized by the boiler is $60{,}181 \times 966 = 58{,}134{,}846$ thermal units.

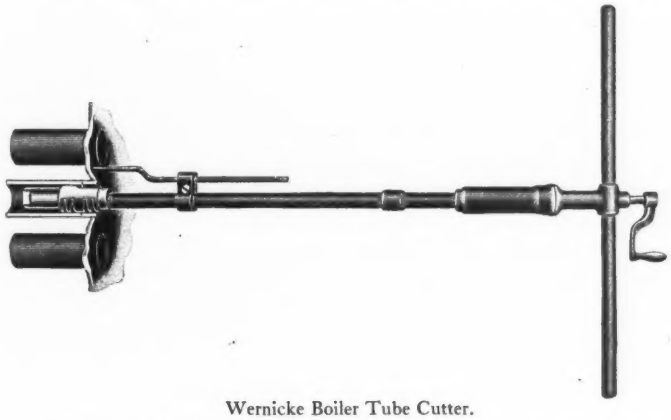
Therefore, the efficiency is—

$$\frac{58,134,846}{74,269,000} = .78 \text{ or } 78 \text{ per cent.}$$

In the above calculations, item 13 is obtained by deducting item 10 from item 9; item 14 is obtained by dividing item 9 by item 10; item 15 is item 13 divided by the number of hours of the test; item 16 is item 15 divided by item 2; item 17 is item 11 multiplied by item 12; item 18 is item 17 divided by item 9; item 19 is obtained by dividing item 17 by item 13; item 20 is item 17 multiplied by the number of heat units required to raise one pound of water from the feed water temperature to the temperature of the steam, divided by item 9; item 21 is the same as item 20 except it is divided by item 13; item 22 is item 17 divided by the number of hours of the test multiplied by 34.5, the equivalent evaporation of one horse power, and item 23 explains itself. For very accurate tests, the heat of combustion of the coal should be obtained by a calorimeter, but for approximating the efficiency of the boiler, the heating value of the coal is assumed, and if the kind of coal used is known, its approximate value can be obtained from our August issue, in which a complete list of coals and their heating value was published, and if any data in reference to steam be required, our January issue for this year contained a complete steam table.—[Ed.]

Wernicke Boiler Tube Cutter.

The accompanying illustration represents a device which has just been put upon the market and which fills a long-felt want. It is known as the Wernicke Boiler Tube Cutter. It will cut tubes or flues in a manner which has never before been thought

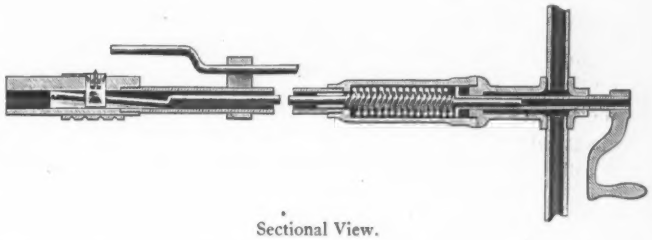


Wernicke Boiler Tube Cutter.

possible. One tool with different size bushings will cut all sizes of tubes from 1¾ inches to 4 inches. It will cut flues inside or outside of boiler and with extension will cut flues at rear of boiler from the front end. As the cutter has a spring feed, it insures an even tension and the tubes are so cut that they do not have to be trued up in a lathe but are left ready for welding.

The operation of the machine is very simple. The proper size bushing is attached to the head of the cutter for the tubes to be cut. After cleaning the tubes, the tool is entered and the guide adjusted to position. The cutter wheel is forced out by means of the handle at the end of the feed rod. The guide is kept against the tube plate and the cutting is performed very similar to the well-known form of pipe cutter. After the tube is cut through, the cutter wheel is drawn back into the head, when it can easily be removed.

The Wernicke Boiler Tube Cutter is manufactured by James



Sectional View.

McCrea & Co., of 67 Washington St., Chicago, Ill., who will be pleased to give any other information desired.

Albany Grease and Grease Cups.

Almost every engineer is more or less familiar with Albany Grease, either by actual experience in using this widely-known lubricant, or by the testimony of other engineers who have found it an article of exceptional merit.

The most obstinate bearing will generally yield unconditionally when Albany Grease is used and whether on slow or fast running machinery, the results are equally satisfactory, as has been frequently demonstrated.

This ideal lubricant is made to suit every condition of climate, and Messrs. Adam Cook's Sons, 313 West St., New York City, who are the only makers, find a large demand for it from all parts of the world. Fig. 1 shows the regular style spindle grease cup manufactured by the makers of Albany

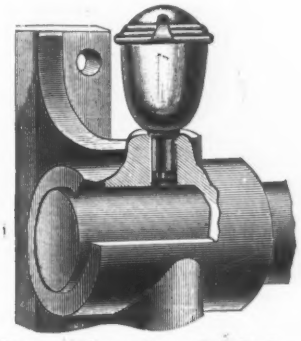


Fig. 1.—Albany Grease Spindle Cup.

Grease, and which they advise being used with their lubricant for the best results. The accompanying illustration tells its own story largely.

The manner of attaching this cup is simple and can be done by any mechanic. A hole is bored through both the cap and brass of sufficient size to allow the outside tube of the cup to come close to the shaft, observing that only the inside spindle rests on the shaft, the top touching the cup cover. The outside tube being shorter, should come within one-quarter or three-eighths of an inch from the shaft. The inside spindle is then removed and the cup filled with the compound. It is only necessary to replace the spindle with a few churning motions and the cup is ready for use. Albany Grease cups require very little attention and cannot get out of order. When filled, they will run from one to four months, according to conditions,

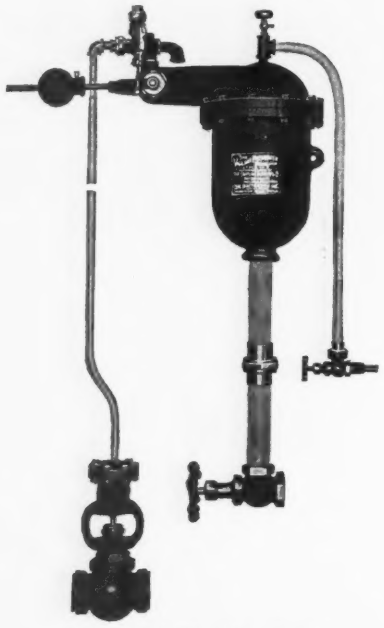
without refilling. They thus affect a great saving in labor as well as in the cost of lubrication. Over oil, of the general quality used in most manufacturing concerns, from 25 per cent. to 50 per cent. has been saved by actual test.

Albany Grease is a pure lubricant, free from all lime, and where it is used with the Albany Grease cup, no drip pan is required; it is self-acting and runs only when the shaft is in motion. The feed is largely regulated by the temperature of the bearings, thus preventing overheating. For dynamos and electrical machinery of every description, Albany Grease is an excellent lubricant.

To prove all they claim, Messrs. Cook's Sons offer to send, free of all charge and expense, one Albany Grease cup with sufficient Albany Grease to test. The only information necessary to send is pipe connection in bearing, depth of oil hole from top of cap to journal, and give particular part of machinery on which the same is to be tested.

The Vigilant Feed-Water Regulator.

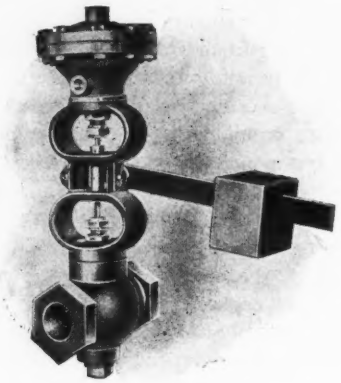
The advantages of regulating the supply of feed-water to boilers automatically by machines in place of by hand is becoming generally recognized and it is largely due to the successful operation of such machines as the Vigilant Feed-Water Regulator, which for the past seven years have been used on boilers of every type and under all conditions, that the prejudice against machines for this purpose has been overcome.



Vigilant Feed Water Regulator.

The machine automatically regulates the supply of water to the boilers so as to keep the level constantly at the middle gauge. They insure dry steam, prevent accidents from low water, prevent water being carried into the engines, prolong the life of the boiler, lessen the repairs, and save fuel by keeping the water level at the proper height.

The complete installation consists of a regulator on each boiler and a governor on the feed pump, which may be either steam or power driven. The machine is operated by the difference in weight of a body suspended in steam and in water, making the action very positive and avoiding the use of any floats or expansion pipes. The action of the machine is such that the valves are either open or shut, so that there is no wire drawing and the valves and seats are not cut.



Pump Governor.

The machine is outside of the column and can be examined at will while the boiler is in operation and by shutting one ¼" valve, the boiler may be fed by hand as if the regulator were not on it. The attendant can tell by looking at the machine whether the boiler is feeding or not. The controlling valve is operated by a plunger instead of a diaphragm and wears indefinitely.

The pump governor is of the type shown and is placed in the steam line of a steam pump or in a by-pass from the suction to discharge pipe of a power driven. The governor is a differential governor maintaining a constant excess pressure in the feed line over the steam pressure and the head forcing the water into the boilers is a constant one, regardless of the variations in the steam pressure. It will be noticed that the excess pressure is obtained by a weight, the latter being considered more exact and constant than springs.

Both machines are made by the Chaplin-Fulton Mfg. Co., 32 Penn Ave., Pittsburg, Pa.

A Universal Belt and Pulley Regulator.

Since power plants came into existence and belt driven machinery came into use, engineers have been trying to solve the problem of slipping belts and many are the devices and methods that have been devised to obviate this difficulty; the one in most general use being the various dressings to the belt.

One man believed that there was a better way—that of attacking the seat of the trouble, the surface of the pulley itself. The result was the product of the Universal Belt and Pulley Regulator Co., 237 Lexington Ave., New York, which consists of a covering resembling leather in appearance and which is easily applied to the surfaces of either iron or wooden pulleys of any size. Besides causing the belt to grip the pulley while passing over it, thus preventing the loss of power caused by its "sliding," the "regulator" is composed of such materials that

the life of the belt is prolonged by being properly "fed."

Knowing the uselessness of trying to introduce an unknown experiment upon practical engineers, its inventor has spent several years in making tests to prove the wearing qualities and practibility of the "regulator," which tests have been so eminently satisfactory that the company feels no hesitancy in putting all of their product out with a five year guarantee back of it. The numerous letters highly commending it, which they have received from engineers in plants where the "regulator" is employed, would seem to prove conclusively that their confidence is not misplaced.

Further information concerning this interesting invention may be obtained by sending your name and address to the manufacturer and if you will incidentally mention "The Practical Engineer" they will greatly appreciate the courtesy.

THE N. A. S. E. CONVENTION.

The Twenty-third Annual Convention of the National Association of Stationary Engineers, held at Richmond, Va., Aug. 2-5, was a delightful, and in every way a most successful affair. There were some 400 delegates in attendance and about an equal number of visitors. The latter consisted principally of members of the National Supply Men's Association but also included many past officers and other active members of the N. A. S. E., who would rather miss their Christmas dinner than the Convention. Most of the delegates arrived on Monday, Aug. 1, and the day was given up to cheers and greetings for the arriving delegations. In the evening a reception was held at Murphy's hotel and proved a very enjoyable affair.

Among the principal events of the Convention was a letter from President Roosevelt, conveying his regards to the members and expressing regret at his inability to be present. The report of the license committee recommended that local associations push the matter of securing license legislation harder than ever before. The opinion of the committee was that although the main features of all engineers' license laws should be the same, minor details must, for obvious reasons, be varied to meet existing local conditions. The subordinate associations were urged to make greater efforts to secure associate and honorary members who have influence and whose advice in behalf of license laws will command attention.

The educational committee reported a successful year and awarded prizes to Massachusetts No. 21, New York No. 15, and Massachusetts No. 15.

The report of the national secretary showed nineteen new associations formed during the year.

The committee on a home recommended that the work be continued, and careful investigation be carried out, looking to the building of a substantial home. They estimated that the cost of maintenance would be $153.00 per year for each inmate.

Louisville, Ky., was selected as the meeting-place for the 1905 Convention.

President Hogan was presented on behalf of the Massachusetts delegation with an ivory gavel, and on behalf of the delegates and supply men with a magnificent silver service.

Other events of importance were the awarding of the contract for publishing "The National Engineer" to the Lanward Publishing Co. for a period of five years and a motion which was passed on Thursday to pay the delegates but four cents a mile. As it was discovered later that many delegates had not understood this latter motion, it was reconsidered on Friday and the five-cent rate was voted.

The election of officers, always a matter of interest, took place on Friday and in this case developed a surprise which was, to say the least, something of a novelty.

Following the usual custom of the association, Vice-President Chas. W. Hart was elected to the office of president without opposition. Then came nominations for vice-president for which there were four candidates: R. D. Tomlinson, New York; E. M. Van Arsdale, St. Louis; Emil Heeger, Evansville, and S. B. Force, of Pittsburg. Mr. Tomlinson was elected on the second ballot. Then came the surprise, when President-elect Hart resigned, making a new election necessary and creating a condition of affairs which was embarrassing to many, until some one nominated Treasurer C. F. Wilson, of Milwaukee, who was elected by acclamation.

Hugh Rainsford, of Cincinnati, was elected treasurer; Frank W. Raven, of Chicago, secretary, and A. T. Peery, of California, door-keeper.

The new officers were installed by Past-President Robt. G. Ingleson, after which the Convention adjourned to meet again at Louisville, Ky., one year hence.

Kensington Council.

Kensington Council, No. 3, A. O. S. E., meets every Thursday evening in A. P. A. Hall, Frankford Ave. and Master Street, Philadelphia, Corresponding Engineer, Stephen Montgomery, 4321 Cloud St., Frankford. At a recent meeting Brother C. W. Leng was presented with a handsome gold badge in recognition of his distinguished services in behalf of the Council.

Owing to the success achieved by the series of lectures given by the Council during the past six months, it is intended to inaugurate another series of lectures (very soon) and as no trouble or expense will be spared, the coming lectures will be, if possible, better than the former ones. A new and efficient stereopticon has been secured which will be used to advantage at all lectures. Due notice of the lectures will be given.

The officers elected and installed for the ensuing half year are: Chief Engineer, Thos. Donovan; Assistant, Richard Lee; Sr. M. M., J. Howard Studholme; Jr. M. M., Frank Smith; Financial Engineer, Harry Myers; Recording Engineer, Dennis Geary; Corresponding Engineer, Stephen Montgomery; Treasurer, Chas. Cook; Chaplain, Chas. Leng; Sentinels, Jas. Reilly and Joseph Wooley; Instructor, Chas. Cook. The Educational Committee is composed of seven hustling members whose names are a guarantee that there will be something doing.

Bath for Nickelling Britannia Metal.

Dissolve two pounds of the double sulphate of nickel and ammonium and 7 ounces of sulphate of ammonium by boiling in 6½ gallons of water and let the fluid cool. In case any acid should still be present, a little hydrochlorate of ammonia must be added.

TRADE NOTES

"No cure, no pay," is the suggestive motto adopted by the Continental Chemical Company, 2923 North Broad street, Philadelphia. They manufacture "C. C. C." boiler compounds, making free analyses of feed waters and preparing a special compound for each case. They have just published a booklet which discusses the subject of incrustation very interestingly. A copy will be mailed free upon request to any engineer interested.

For Corliss valve stems, ammonia compressors, heavy duty pumping engines and other points where the service on packing is particularly severe, a trial of Larkin's metallic packing may prove a money and a labor saver. This packing is made of the best frictionless metal, so thoroughly incorporated with graphite that it is always self-lubricating and thus practically frictionless. The makers say that it will hold the highest pressures absolutely tight, and as it can be used over and over, it is almost indestructible. An interesting booklet, explaining all about it will be sent free upon request, to any one mentioning The Practical Engineer. Address the Pennsylvania Electrical and Railway Supply Company, Pittsburg, Pa.

Mr. Charles T. Allen, president of the Union Steam Pump Company, of Battle Creek, Mich., has been elected president of the City Bank of that city, which is an old and important financial institution. Mr. Allen has had a thorough banking experience and an extensive and successful business career. To his excellent management is chiefly due the magnificent success of the Union Steam Pump Company, with which all engineers are familiar.

Among the blast furnaces which Mr. D. W. Patterson has equipped recently with the Vigilant Feed Water Regulators are the Wharton Furnaces, Wharton, N. J.; E. & G. Brooke Iron Company, Birdsboro, Pa.; Paxton Furnaces, Harrisburg, Pa., and the Robesonia Iron Company, of Robesonia, Pa. A handsome catalogue describing this interesting regulator in detail will be mailed to any one mentioning The Practical Engineer.

Four steam specialties, each of interest to every engineer, are illustrated and described in an attractive circular sent out by Frank L. Patterson & Co., 24 Cortlandt street, New York City. If you have not received one, write for a copy at once.

Dodge & Day, Modernizing Engineers, Philadelphia, have just completed the installation of the 340 horse-power Buckeye vertical, cross-compound engine, direct connected to two G. E. 110 kw. continuous current, compound-wound generators for the Link-Belt Engineering Company. The same concern is at work on a three-motor, electrically-operated locomotive crane for this company, to handle beams, angle irons and other heavy structural material for use in their new storage yard.

William Milligan, the well-known and popular Philadelphia steam fitter, 726 Sansom street, has been appointed sole agent for the Improved Stillman-Carmichael Damper Regulator. Mr. Milligan is also agent for the specialties of the Watts Regulator Company, including steam, water and pump regulators, steam traps, boiler oil feeders and reducing wheels. Illustrated circulars and prices will be sent upon request.

Perhaps the best proof of the popularity of any product is the demand for it. Sometimes this demand is the creation of publicity, but when the demand increases constantly and over a long period for any article of commerce, it can usually be credited to real merit, and in this respect the demand for Keystone Grease is interesting, for the manufacturers say that their sales have doubled every year for several years past, and in spite of the so-called "business depression" the demand for Keystone Grease continues to grow. The makers are still continuing their liberal policy of sending a sample can of their grease and a brass cup free. If any reader desires to give it a trial he should write at once, mentioning The Practical Engineer. Address Keystone Lubricating Company, Twentieth street and Allegheny avenue, Philadelphia, Pa.

Booklet "N," published by the Dearborn Drug and Chemical Works, 27-34 Rialto Building, Chicago, will interest most engineers. If you want to get one, write for it at once. Don't wait for the Dearborn agent to come around. They may be all gone.

"Care and Handling of Electric Plants" is the title of a most excellent book which should be in the hands of every engineer who is handling or ever expects to handle an electric plant. It is published by Spon & Chamberlain, Department P. E., Liberty Building, New York, Price, $1.

Engineers who are not familiar with the Garfield Double Jet Injectors and Chicago Sight Feed Lubricators should write for catalogue to the Ohio Injector Company, Wadsworth, Ohio.

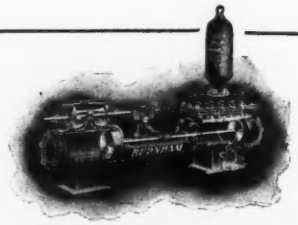
Mr. Jere F. Arringdale, formerly traveling representative for the Reliance Safety Alarm Column in the East, is now connected with Mr. D. W. Pattison, Harrison Building, Philadelphia, in the same capacity. He is representing the Vigilant Feed Water Regulator and Fulton Pump Governor for feeding water to steam boilers automatically. These machines are manufactured by the Chaplin-Fulton Mfg. Co., 32 Penn avenue, Pittsburg, for whom Mr. Patterson is Eastern sales agent. Catalogue will be mailed upon request.

Sayen & Shultz, Thirteenth and Commerce streets, Philadelphia, are large manufacturers of mechanical rubber goods, including rubber valves and discs of a most excellent quality, and a special sheet gum packing which they call "Auto" because it is made from the scrap waste of the finest Para rubber used in making automobile tires. They also make a rubber tobacco pouch which they will send free to any engineer interested.

A 96-page booklet free to every engineer is the offer of the Lake Erie Boiler Compound Company, Chicago street, Buffalo, N. Y. Seems to be worth a postal card to any one interested in keeping boilers clean.

It is an interesting fact that the General Electric Company has selected Cochrane Feed Water Heaters for its plants at West Lynn, Mass., and Harrison, N. J., where Curtis steam turbines are to be installed. These heaters are rated at 3000 and 1000 horsepower respectively and will take the exhaust steam from the auxiliaries. Three 5000 h. p. Cochrane Heaters have also been installed in connection with steam turbines at the Delway (Mich.) station of the Detroit Edison Company, and a 600 h. p. Cochrane Feed Water Heater will be used in the new turbine station of the Iowa and Illinois Interurban Railway Company, Clinton, Ia. A 2000 h. p. Cochrane Heater, which has been ordered by the Electric Company of America, will be installed with steam turbines in their new plant at Marion, Ind.

Messrs. Adam Cook's Sons, 313 West street, New York, have issued an attractive booklet containing much interesting data re-



Union Steam Pump Company

BATTLE CREEK, MICHIGAN

Manufacturers of the

GREAT BURNHAM

STEAM PUMP

The Pump that won't short Stroke.

garding their cups and Albany Grease, copies of which they will be glad to send readers of The Practical Engineer upon application.

The Cancos Manufacturing Company, of Philadelphia, the manufacturers of "Black Squadron Four Wedge Ring Packing," steam and hydraulic packings of every description, have prepared a convenient little memorandum book for engineers which they send free upon request. This book contains miniature maps of the United States and its island possessions, Canada, Mexico and South America, populations of cities in the United States, calendar, postal regulations, weather bureau signals, mensuration and other mathematical rules, weights and measures, data about coal, and other useful information, besides square-ruled pages for notes and memoranda.

A catalogue that tells about pipe coverings, the different grades and their uses, will be mailed free to any engineer sending a postal card request to the Norristown Pipe Covering Company, Norristown, Pa.

The Buffalo Air Injector is the best and cheapest device for compressing air in connection with pneumatic elevator plants. Write for catalogue describing them to John G. Stamp, Engineer, 202 Main street, Buffalo, N. Y.

"The Penberthy Bulletin," a neat little monthly journal containing good information for engineers, will be mailed free to any reader of The Practical Engineer for three months, commencing with the October issue. If you want it, write at once to Penberthy Injector Company, 344 Holden avenue, Detroit, Mich.

The object of the Lamprey Protective Arch Plates is to protect boiler fronts from burning out, preserve the brick work, save fuel and increase boiler efficiency by giving added heating surface. That they do all of these is attested by a large number of users. Engineers interested should write for catalogue to the Lamprey Company, Westfield, Mass.

Jenkin Bros., 71 John street, New York, have just issued a very fine booklet entitled "Valve Troubles, and How to Avoid Them." The first part of the booklet is devoted to a summary of the difficulties, if any, commonly encountered in the installation and use of valves, together with some suggestions for the remedy of such difficulties.

The balance of the booklet is devoted to the illustration and description of the principal types of valves manufactured by them. The first valve illustrated is the regular Jenkins Bros. Globe Valve, which is the type of valve most extensively used to-day, there being comparatively few plants in the United States where at least some of these valves are not in use, nor few experienced engineers who do not have some knowledge of their merits. The extra heavy brass valves are next shown, these valves being designed for a working steam pressure of 150 to 300 pounds, or for hydraulic pressures up to 1000 pounds.

The booklet is illustrated with half-tones throughout, the description of the "Excelsior" Straightway Back Pressure Valve and Safety Valves being especially valuable. Every engineer should obtain a copy of this booklet, which can be had upon request.

The latest catalogue of the United States Metallic Packing Company, of 427 North Thirteenth street, has just been issued. It describes in a very clear manner how this class of metallic packing should be used, and gives a half-tone diagram of the "Ideal" method of lubricating their metallic packings on stationary and marine engines.

The practical feature which has made the United Etates Metallic Packing so popular has been the fact that they are manufactured and designed to suit the work for which they are to be used, which keeps them constantly up to the requirements of the times, and by this constant improvement have kept pace with modern steam engineering practice.

A card mentioning The Practical Engineer will bring one of their booklets to you.

IF ENGINEERS will send $1.00 to the address below they will receive two blue prints, with tables and instructions, showing how to set valves and eccentrics on Corliss engines, simple and compound, with one and two eccentrics.

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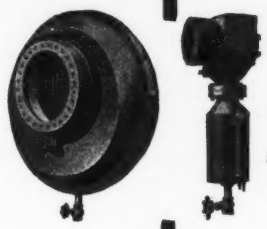

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Does It Contain Scale Forming Matter?

Then you will probably want to run surface condensing. There is just one way to do this satisfactorily. Take the oil out with a Cochrane Vacuum Oil Separator before the exhaust steam is condensed The problem of removing oil from exhaust steam, that is afterwards condensed in a surface condenser, is a difficult one, involving as it does the careful consideration of the quantity of steam to be handled, the drainage, method of installing, etc., but the satisfactory results that have been obtained—as evidenced by the many installations placed in service during the past ten years—lead us to believe that we have correctly solved the problem by the aid of our Cochrane Vacuum Oil Separators and that we can solve any similar problem and give satisfactory service.

If you are interested in any type of separators for removing water or oil or other foreign substance from live or exhaust steam, write for our catalogue, **16-S.**

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Manufacturers of Cochrane Feed Water Heaters, Cochrane Steam and Oil Separators and the Sorge-Cochrane Systems.

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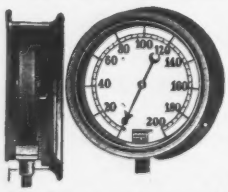

We claim particular merit for our gauges and mention several of the numerous points of superiority.

Mechanism is independent of case.

Material used is selected on account of having wearing qualities that will outwear two gauges of stock generally used.

They are non-corrosive, attractive and accurate.

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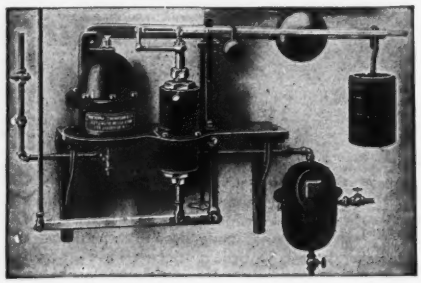
New York Office, 141 Broadway Chicago Office, 58 Washington Street
PACIFIC COAST AGENTS,
Geo. H. Tay Co., San Francisco and Los Angeles, Cal., Seattle, Wash.



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Indicators, Reducing Wheels, Planimeters, etc.

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We will impart the secret to you. They are higher priced and very much better than the ordinary kind for all *HARD-TO-FILL* places.

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No advance. No registeration fees. We charge for results ONLY that proves the character of this exchange.

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P. P. P.

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Will clean ANY engtth tube.
In operation EQUALLY balanced, insuring NO back pressure against operator.
Is the LIGHTEST and EASIEST cleaner to handle.
Has NO working parts.
Its force is tremendous.

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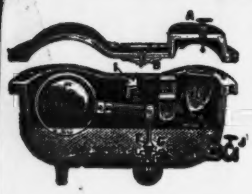

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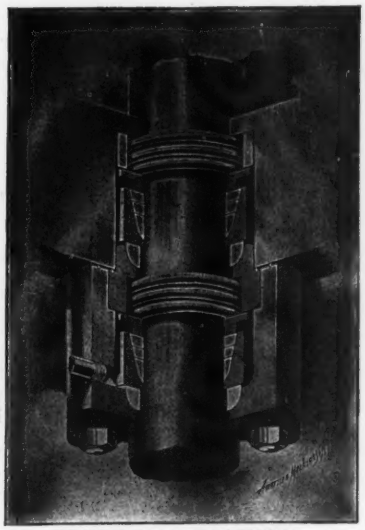

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Their use will save you considerable money and endless trouble.
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and if interested in Boilers and Boiler Tube Cleaners
will want to see **THE BEST,** and that is of course

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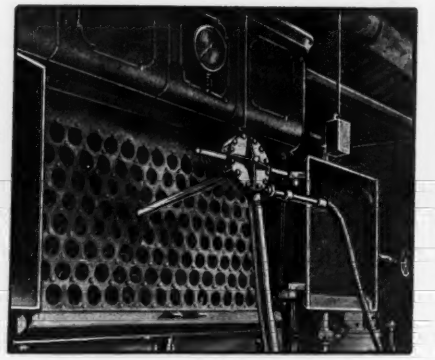

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The Liberty Turbine Boiler Tube Cleaner

will clean tubes more thouroughly, at less cost, and in less time than can be done by other means.

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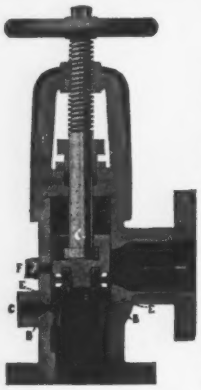

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The Faber Blow-off Valve

washes its face every time it is opened and closed.

A connection at C admits steam at boiler pressure to chamber B, whence it escapes through slot E all around the seat, and sweeps both seat and disk free from sediment just before closing. It will last as long as a steam valve without leaking.

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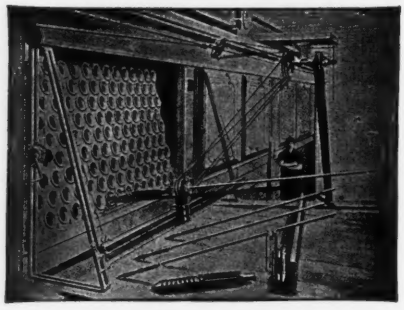

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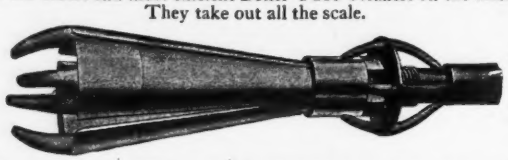
POWER OR IMPULSE

Are the oldest and most efficient Boiler Tube Cleaners on the market. They take out all the scale.



The Gem Flue Scraper

does the same for Smoke Flue Boilers

We also make **Gem Oilers,** Patent or Plain, **Torches and Heavy Brazed Steel Oilers, Flexible Shafting, Loose Pulley Lubricator.**

Write for Catalogue and Prices.

Gem Manufacturing Co.

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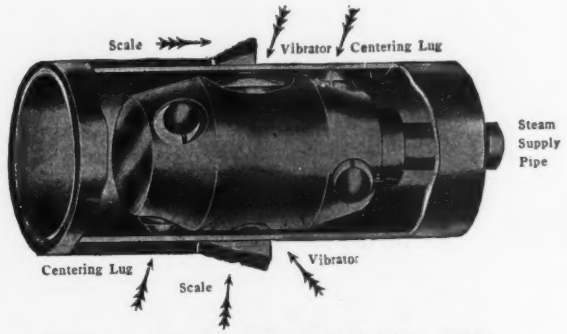

WHEN SUCH OVERWHELMING TESTIMONY CONFRONTS YOU WHY PERSIST IN WASTING A FORTUNE WHEN WE WILL GLADLY SEND YOU A "TORPEDO" ON "SUSPICION." REMEMBER THAT THE "TORPEDO" IS HARMLESS TO THE TUBE AND WILL LAST A LIFETIME.

A large reproduction of pile of scale referred to will be sent upon request. Write us.

OFFFICE OF

MINERAL POINT ELECTRIC LIGHT CO.

H. S. WEIL, Manager

Mineral Point, Wis., 6-15, 04.

THE GENERAL SPECIALTY CO.
Buffalo, N. Y.

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Yours truly,
MINERAL POINT ELECTRIC LIGHT CO.
By H. S. Weil, Mgr.

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We and our predecessors have made Red Star Boiler Compound for over twenty years.

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Don't Miss The Practical Engineer for October

THIS issue of The Practical Engineer is perhaps the best that we have ever published. Every line of editorial matter has been prepared or selected with careful regard for the interests of our engineer readers.

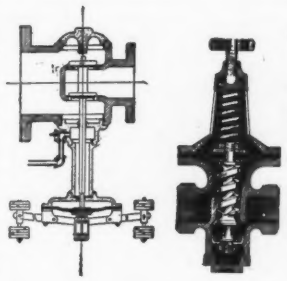
Beginning nearly eight years ago, we have earnestly endeavored to make each and ever issue of The Practical Engineer an improvement on the preceeding number, and we think that most of our old time friends who have continued their subscriptions from year to year since the beginning will agree with us that it is now the best engineers paper ever produced at such a low price.

That its editorial matter is authentic, reliable and thoroughly appreciated by engineers is evidenced by the constant and rapidly increasing number of subscribers.

Next month we will publish a statement showing the exact number of copies printed and mailed each issue for several months past. This statement, which will be absolutely correct will be interesting to our old friends, and in its way, most remarkable, for it will show a growth in paid circulation, seldom if ever equalled by a mechanical paper.

Don't miss the October number

WILLIAM MILLIGAN 'Phones: Bell-Walnut 1271a Keystone-Main 1-71 726 Sansom Street, Phila., Pa.



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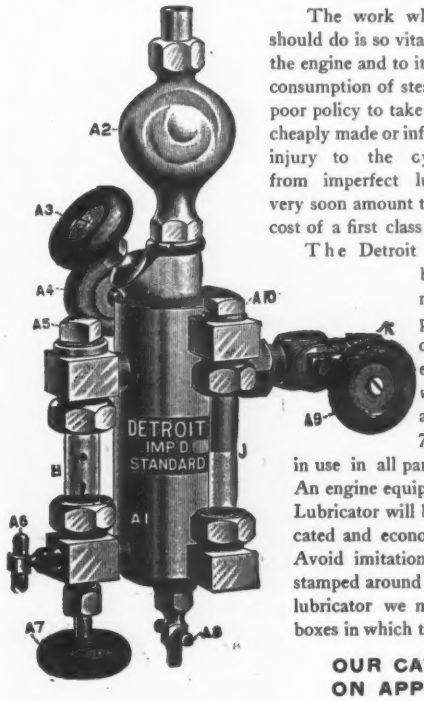

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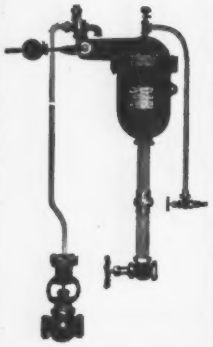

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OCTOBER

In the October issue of The Practical Engineer we will publish a statement giving the exact circulation of each issue of The Practical Engineer for more than a year past. It will interest you.

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who really wants to get on should "get on" to the fact **that** the

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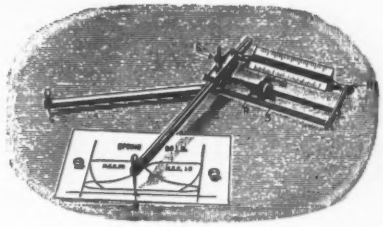
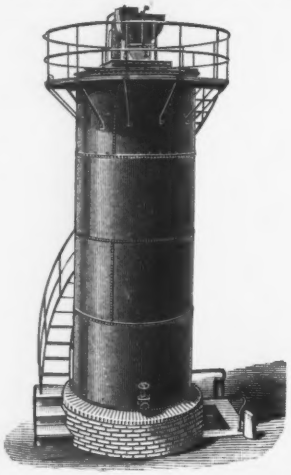


You Don't Drink

impure water if you can get it pure; then why feed your boilers on a water that is going to lead to a youthful grave and to early gray hairs.



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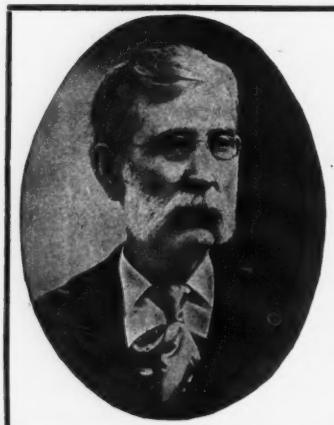

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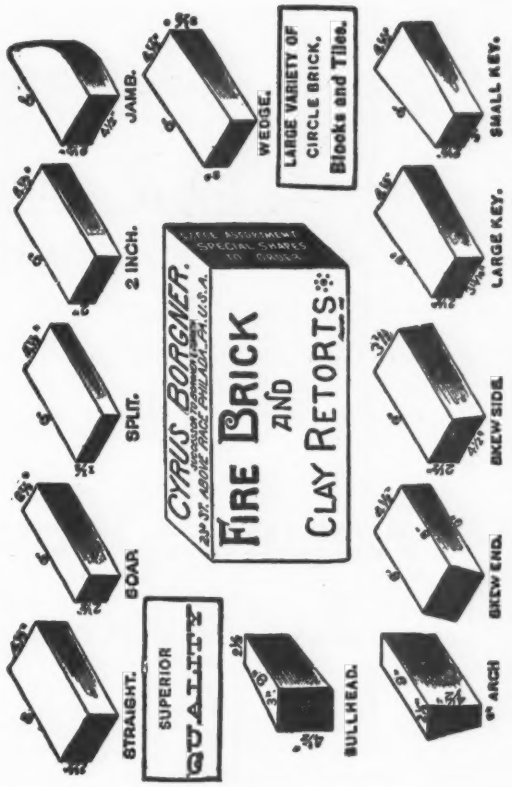

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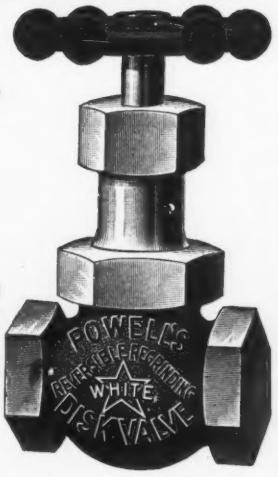

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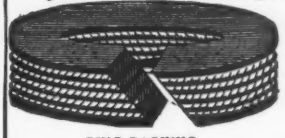

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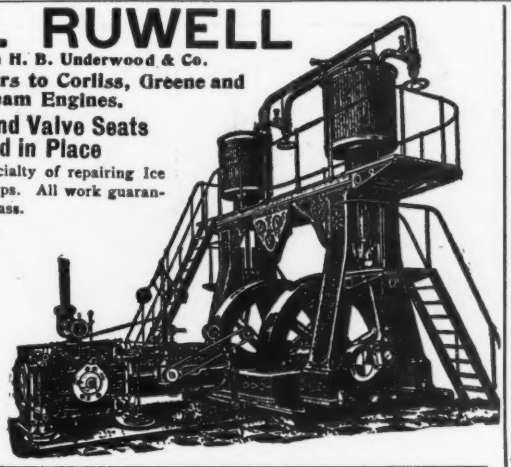

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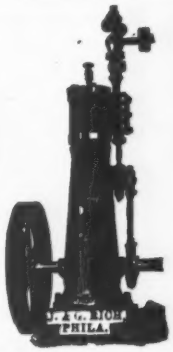

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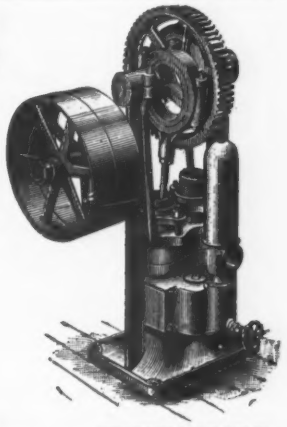

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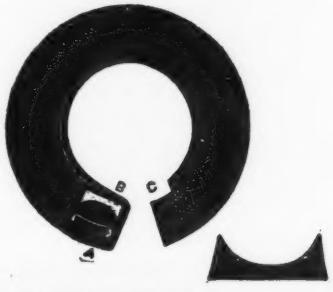

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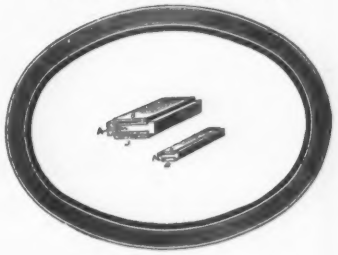

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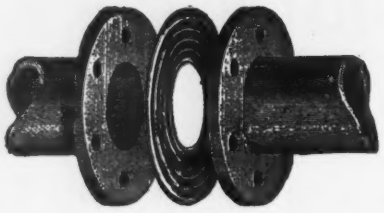

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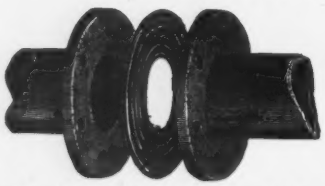

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A well known engineer recently said "I am perfectly confident from my own experience that an engineer who has once tried BLACK SQUADRON will not use any other."

Send us your name and business address and we will send you a supply of BLACK SQUADRON FREE of COST all charges paid.

CANCOS MANUFACTURING CO.
146 N. 2nd St., Philadelphia, Pa.

STEAM FITTING

if not properly done, in any plant, will cause the engineer a great deal of trouble, and his employer unnecessary expense. Many years of practical experience and a force of competent assistants enables me to guarantee absolute satisfaction.

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ESTABLISHED 1855

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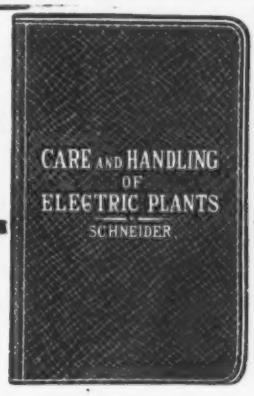

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Send us two ounces of scale, by mail, or one gallon of water, by express prepaid. We shall make an analysis free of charge, and give you our opinion of the grade of Compound you should use in your boilers.

RED SEAL BOILER COMPOUND

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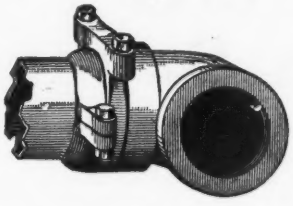
Permanent Results

can be obtained only by using Smith's Clamp for stopping leaks in pipe joints.



This Clamp is simple in construction and is guaranteed to

STOP THE LEAK

Made in all sizes, brass or steel Send for circular and discounts.

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Watt's Perfect Wedge Packing
FOR EITHER HIGH OR LOW PRESSURE

Holds steam, water, air or ammonia with less friction on the rod than any other. Write for trial order today.

Watt's Best Sheet Packing

It is best because it makes any kind of a joint tight and keeps it tight. Used for oil, acid, steam, ammonia and water. It is the lightest and purest Rubber Packing made and can be used over again, and will not become hard under the highest steam pressure.

Manufactured by JOHN M. WATT'S SONS
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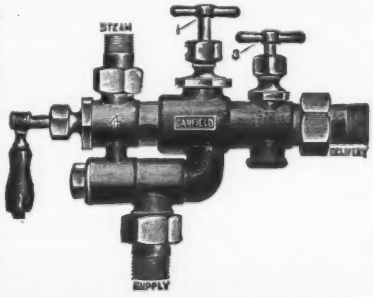

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Equipped with Garfield, Double Jet Injectors and Chicago Sight Feed Lubricators are as satisfactory to the owner as to the engineer.

Boilers steam easily and engines run smoothly.

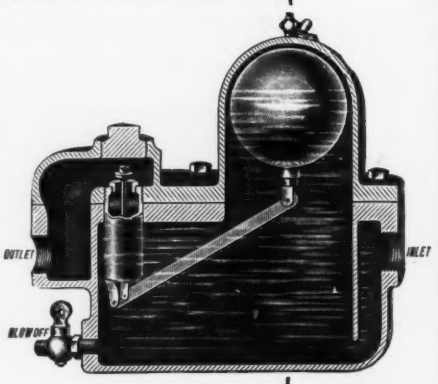
Send for catalogue and mention THE PRACTICAL ENGINEER.

The Ohio Injector Company
WADSWORTH, OHIO

The Wright Idea in a Low-Pressure Steam Trap

is one having a valve that is **approximately as large as the pipe connection.** With a valve of this kind there can be no doubt about the Trap's ability to take care of all the condensation that comes to it. Isn't that reasonable?

And, by the way, when a Trap is working on low-pressure, the condensation doesn't come to it in **homeopathic doses.** A good Low-Pressure Steam Trap must have a valve capacity capable of handling a **flood** if necessary.



The Wright "Victor" Low-Pressure Steam Trap

wins out on that point. Put it at work on any steam pressure from 0 to 20 pounds—then forget it. It will be there ready for whatever amount of condensation comes to it.

Write us for particulars to-day—or tomorrow if it suits your convenience better—but write us.

WRIGHT MANUFACTURING CO.

72 Woodbridge Street DETROIT, MICH., U. S. A.

How about this Trap for your Heating System ?

STEAM TRAPS "Nason" and "Sidelug"

"Nason" Trap
For pressures to 70 lbs.

THE STANDARD FOR SIXTY YEARS

"Sidelug" Trap
For pressures from 70 to 150 lbs.

The practical engineer wants nothing but practical devices in his plant. The simplicity of the "Nason" Trap renders it eminently practical. Its design embodies the only correct principle, as is evidenced by its large and continuous sale since its introduction in 1842.

All parts of the "Nason" and "Sidelug" Traps are so removed from contact with dirt and scale as to render their stoppage impossible, thereby indefinitely prolonging their integrity.

Nason Traps are "built for business"—no flimsy material and slip-shod workmanship—consequently no trouble and no leaks.

Wherever condensation is to be removed without waste of steam the "Nason" and "Sidelug" Traps can be successfully applied.

Every Steam Trap Bearing Our Name is Tested and Guaranteed. Reject Imitations.
Complete Catalogue on Application.

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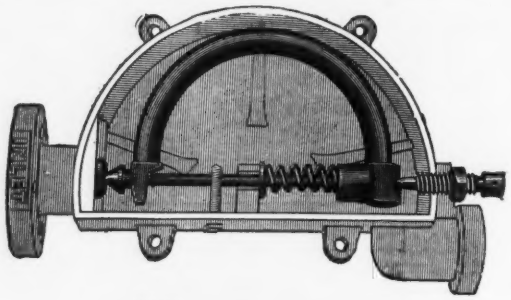

Heintz Steam Savers

When properly installed—and we furnish plans and instructions without charge—the Heintz will save at the coal pile, its cost several times a year, besides increasing greatly the efficiency of any heating system or steam controlled apparatus to which it may be attached.

Reliable, accurate, durable, no floats, no complications, just results. Guaranteed or no pay.

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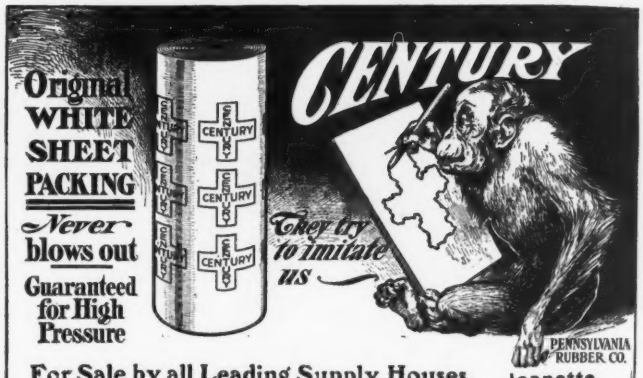
RIALTO BUILDING, SAN FRANCISCO, CAL.



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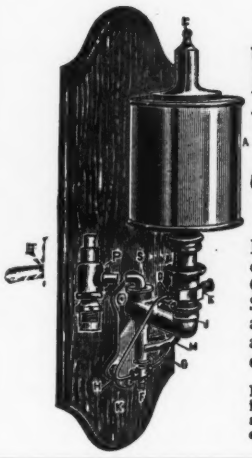
THE CARR PUMP GOVERNOR

Superior to any pump governor on the market "why" Because the cylinder will not LIME, Prevents the pump from RACING in case of a bursted main or hose, Fitted with Renewable Compensating Valve and Seats, Regulation perfect. Especially adopted for Fire and Water Works Pumps, Send for catalogue, 30 days trial.

E. M. CARR,
NEW CASTLE, IND., U. S. A.



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Kellam Damper Regulators
The Simplest and Closest Damper Regulator.
Manufactured by
J. E. Lonergan & Co.
211 RACE ST., PHILA., PA.

Brass Founders and Finishers and Makers of Pop Safety Valves, Water Relief Valves, Oil Cups and Lubricators, Steam Pressure Regulators and other safety steam appliances.

Old Kellam Regulators Repaired. Correspondence Solicited. Mention this paper if your inquiry is prompted by the sight of this advertisement. Catalogue D free on application.

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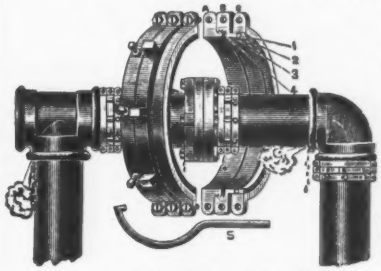


To look over heating pipes, and repair leaks economically with the CLIMAX STEAM JOINT CLAMP which is the only practical device for the purpose.

If your supply house does not have them order direct from the Manufacturers.

JAMES McCREA & CO.
67 W. Washington Street, CHICAGO
Send for Catalog showing other money savers.

Lindstrom's CORLISS VALVE STEAM TRAP

A GREAT EMERGENCY TRAP

No packing of any kind required, the cover being ground.

The Corliss Liberating Valve. Always on seat. No scale or grit can get between this valve and seat.

An automatic alarm whistle. A great feature.

No pins or screws used in connecting the valve mechanism.

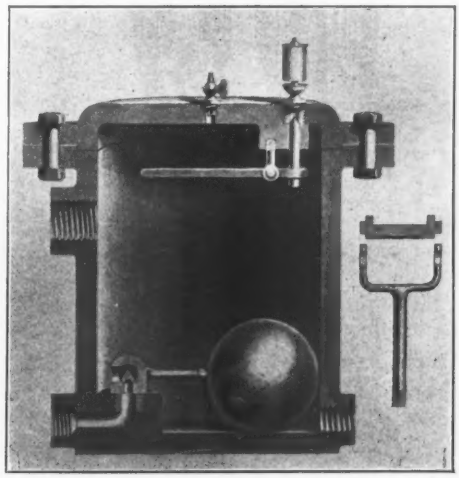
The centre of the valve being the fulcrum, gives the float great lifting power.

Cylinders Rebored

All types and sizes of Steam Engine Cylinders, Valve Pockets, Pumps, and Air Compressors Rebored in present position, from 4 to 76 inches.

Separator

That will keep the water in the boiler. Impossible to get water over to the engine cylinder.



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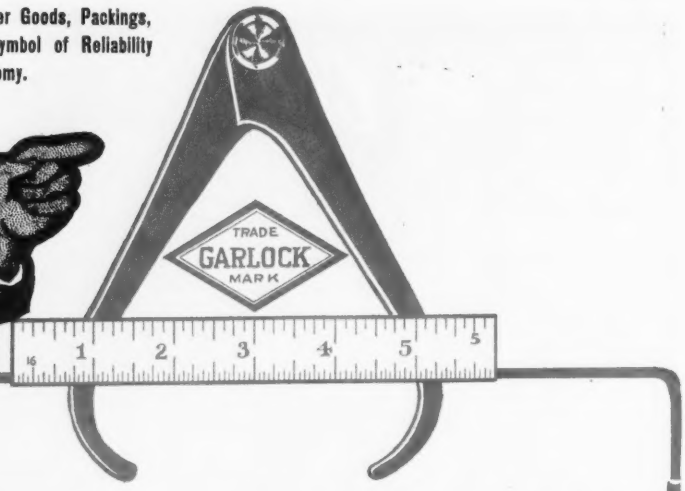
THIS TRADE MARK on Mechanical Rubber Goods, Packings, Hose, etc., is a symbol of Reliability Efficiency and Economy.



AS ENGINEERS are deeply interested in goods of merit that enter into the operation of their plants, we present in the following two of Garlock Packings which are absolutely Reliable, Efficient and Economical, and stand without an equal in the world.

This is a broad statement to make, but our experience of the last twenty-five years, and the results of tests made in the largest power plants in the world, which have adopted our goods, warrant the assertion. We invite the hardest tests and the fullest investigation of their merits.

The Garlock Brass Wire Inserted Sheet Packing, No. 600

This is the sheet that has made the Garlock Sheet Packings famous. It is made of our celebrated Sheet Compound and fine brass wire. It is absolutely impossible to blow this packing out under the very highest superheated steam pressures.

For vibrating joints it stands alone.

The Garlock High Pressure Ring Packing, No. 200

is the only fibrous packing that gives entire satisfaction on high speed and marine engines or locomotives, rods running in oil, grease or chemicals. Excels every other packing for expansion joints.

One of the best proofs that we have the only successful High Pressure Packing on the market is that it is imitated by every important manufacturer of packing in the world, but has never been equalled.

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Send for Free Sample and Catalogues to Our Nearest Office

WHEN THE

BOILER FEED-WATER

contains objectionable ingredients, such as SCALE-FORMING MATTER, it deposits as scale, regardless of the type of boilers, the steam pressure carried, or the care and attention with which the boilers are operated.

There are all sorts of beautiful theories launched for the prevention and removal of scale, but we have never seen any other practical way of keeping the boilers clean than by causing

CHEMICAL REACTIONS

to take place between the scaling-salt and some reagent which converts these incrusting solids into such condition that they will not adhere as scale, but can be blown out and readily washed out when boilers are open.

To accomplish these results without injurious action to boilers, it must be done with a *vegetable treatment* properly proportioned to suit the water, as per analysis. Vegetable Treatment requires high temperature to best bring about the reactions and should, therefore, be used through the heaters to the boiler, or direct into the boilers.

Send us a gallon sample of water for complete Mineral Analysis. We will send you report and our proposition, telling you the treatment required, amount necessary to be used, the price, etc.

NO MATTER WHERE YOU ARE LOCATED, we can point to many boiler plants we are successfully keeping clean not far from you.

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The Patterson-Berryman Feed Water Heater and Purifier

IMPROVED TO DATE

By means of exhaust steam from the engine, it supplies pure hot water for boilers (or other purposes) at 200 degrees F. or above, saving fuel which would otherwise be used in heating the water to that temperature.
This means a reduction of from 10 to 20 per cent. of the coal bill.

PATTERSON BELT PUMPS

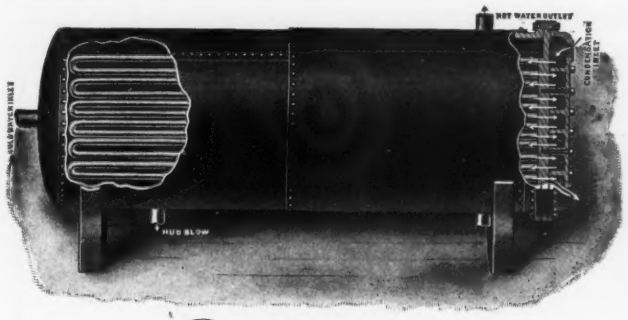
Every engineer knows how extravagantly steam pumps use steam. The power required for a Belt Pump would hardly be missed. And it is not necessary to buy one of the expensive kind. Ours is simple, strong and fully guaranteed.

PATTERSON EXHAUST HEADS

Are you tired of having that exhaust pipe spattering greasy spray over the roof, walls, walks and your clothes? Possibly the neighbors are too.
Wouldn't it be better if the vapor floated away *dry and noiselessly?*

FRANK L. PATTERSON & CO.

24 CORTLANDT STREET **MANUFACTURERS** **NEW YORK**



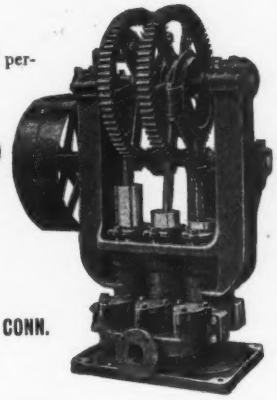
THE GLEANER
TRADE MARK

The **Gleaner** represents the acme of perfection in feed water heating.

THE

Davis Triplex Power Pump

is a perfect type of the vertical triplex belt driven pump.



MANUFACTURERS OF
The "Berryman" Feed Water Heater and Purifier.

I. B. DAVIS & SON, HARTFORD, CONN.

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THOS. McADOO, 125 N. 4th St., Philadelphia

THE **OTIS** Tubular Feed

WATER HEATER, OIL SEPARATOR and PURIFIER

with Seamless Brass Tubes

Guaranteed

To heat the feed water to the boiling point (210 or 212 degrees) with the exhaust steam without causing any back pressure, **also to extract the oil from the exhaust,** so that the exhaust steam after being passed through the heater can be used for heating purposes, and the water of condensation for the heating system be returned to the boiler without the additional expense of an eliminator.

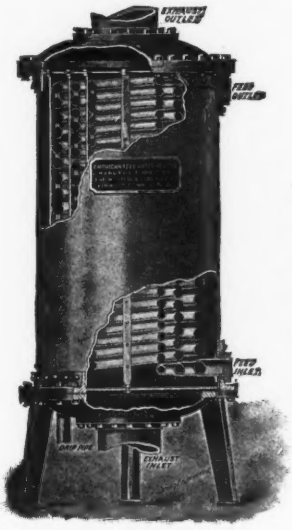
A Liberal Offer

If this heater fails to give satisfaction in every respect, we pay freight, cartage, etc., both ways.

The Stewart Heater Co.

11 Norfolk Avenue, Buffalo, N. Y., U. S. A.

THE AMERICAN STANDARD COPPER COIL FEED WATER HEATER



Simplicity!
Strength!
Economy!
A Money Saver!

It gives so little trouble that one of our customers, who has used one for three years, had forgotten that he had it when we asked him the other day how it was doing. He called in the engineer, who said it hadn't been touched since it was put in and was still heating the water to 210 degrees.

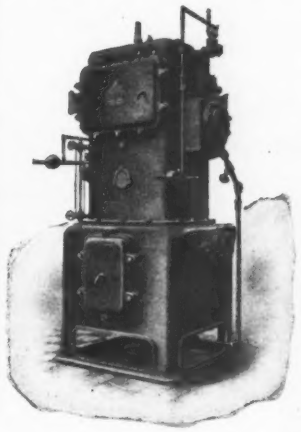
That's the kind of a Heater you want.

Write for Catalogue No. 100 P

The Whitlock Coil Pipe Co.

HARTFORD : CONNECTICUT

INTERESTING.



A great New Hampshire paper mill, that had been using our heating system, concluded to add also a

WEBSTER FEED-WATER HEATER AND PURIFIER.

They found that this addition, with a few changes in piping, effected a saving of about A TON OF COAL A DAY.

Compare the cost of the heater and of the coal saved, and figure out the yearly profit. It's interesting.

Write for booklet F 13. It's interesting too.

Warren Webster & Co.

CAMDEN, NEW JERSEY

F

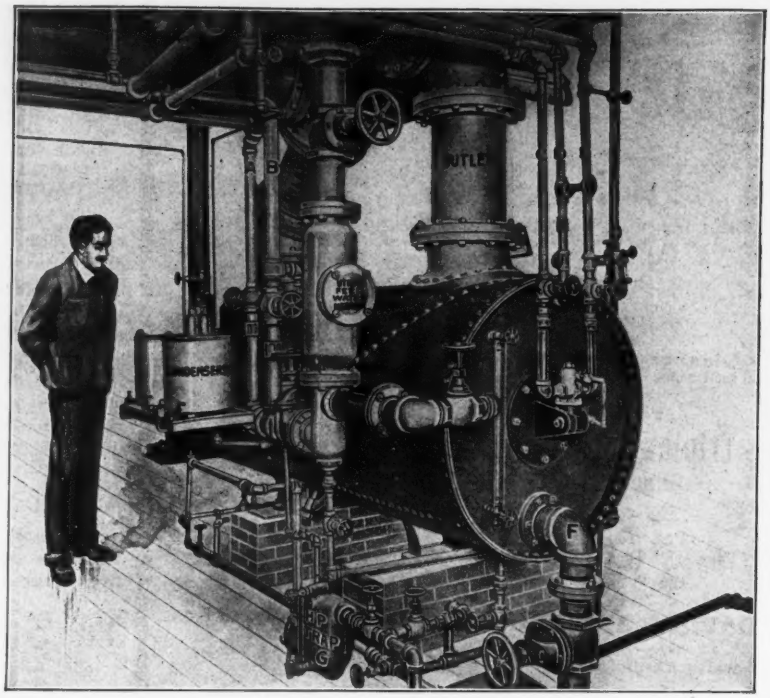
"UTILITY"

EXHAUST MUFFLER, OIL SEPARATOR, RETURN TANK, PUMP GOVERNOR AND FEED WATER HEATER

HERE'S THE WAY WE PROVE OUR CLAIM.

See those two condensers just in front of the man? We condense the steam before and after it passes through the separator of our "UTILITY" COMBINATION and submit the samples for analysis just as they are drawn.

There isn't another separator manufacturer in the world that would dare do that with a separator that has been in use any length of time, but we leave the condensers on permanently if desired and after years of use the elimination of oil is as complete as in a new apparatus.



The "Utility" Combination

Serves as exhaust muffler, oil separator, return tank, pump governor, and feed water heater. It costs only about as much as a feed water heater, and heats the feed water to about the same temperature as the exhaust steam.

We mention a few of the late and up-to-date plants that have adopted the "Utility" Combination

R. H. MACY & CO.,	3,000 H. P.	HOTEL BELMONT,	2,000 H. P.
METROPOLITAN LIFE INS. CO.,	1,900 "	MUSEUM OF NAT. HISTORY,	1,800 "
METROPOLITAN LIFE INS. CO.,	700 "	MANHATTAN LIFE INS. CO.,	1,000 "
PRUDENTIAL LIFE INS. CO.,	2,500 "	MET. MUSEUM OF ART,	1,000 "
MUTUAL LIFE INS. CO.,	1,000 "	MET. MUSEUM OF ART,	850 "
MUTUAL LIFE INS. CO.,	700 "	WALL STREET EXCHANGE,	1,200 "
MUTUAL LIFE INS. CO.,	400 "	WHITEHALL BUILDING,	1,000 "
		HOTEL IMPERIAL,	1,000 "
		MARTINIQUE APARTMENTS,	1,000 "
		BLOOMINGDALE BROS.,	1,000 "
		PERRY PAYNE CO.,	1,000 "
		TRINITY CORP. W. BLDG.,	1,000 "
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		MERCHANT'S REFRIG. CO.,	800 "
		MERCHANT'S REFRIG. CO.,	500 "
		MERCHANT'S REFRIG. CO.,	350 "
		CENTRAL BREWING CO.,	1,000 "

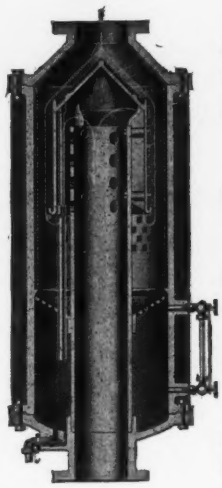
Why was the "Utility" selected for these and many other steam plants? Because we have proven by chemical tests that our system according to horse power saves thousands of dollars per year in running expenses. We can do the same for you.

"Utility" Pump Governor Best Pump Governor on the market because the Valve will not leak or stick. We guarantee it to absolutely govern the pump and remain tight for five years.

THE STANDARD STEAM SPECIALTY CO., 542-544 W. Broadway, CITY OF NEW YORK. "Utility" Steam Specialties.

PHILADELPHIA OFFICE: 341 Bourse Building.

Sweet's Separators



Our steam separators deliver steam containing less than one half of one per cent. of water.

Our oil separators remove 99 per cent. of the oil.

We can prove they do it and give good reasons why.

In addition they have size and are machines.

Made in all styles, also make Exhaust Heads and Steam Traps.

Direct Separator Co.

220 Marcellus Street

Syracuse : : New York

The Baum Separator

Horizontal Style for Live Steam or Oil Service.

For Live and Exhaust Steam
RESULTS GUARANTEED

For condensing systems use the BAUM VACUUM STYLE OIL EXTRACTOR.

Most satisfactory Separators on the market. Ask why.

The Baum Separator and Machine Company

Manheim, Pa., U. S. A.

Vacuum Style Oil Extractor.

Philadelphia Agents, AMERICAN SUPPLY COMPANY, 612 Betz Building

BERRYMAN
Feed Water Heaters and Purifiers

WATER TUBE AND STEAM TUBE

Cast Iron or Steel Shells. "U" Shaped Seamless Drawn Brass Tubes.

We Build Heaters for Every Purpose and Condition

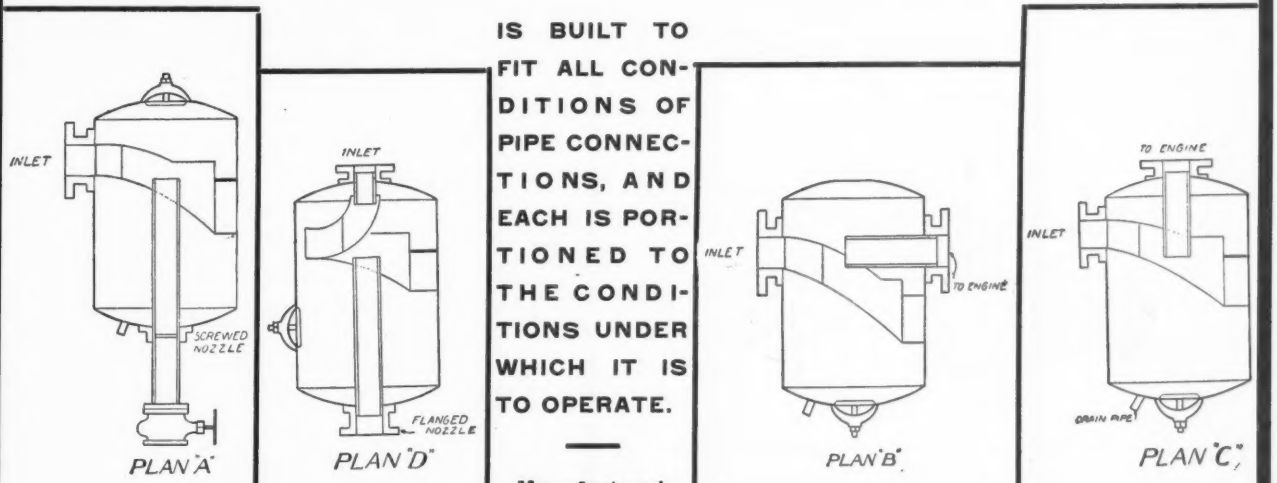
THE KELLEY PATENT

IMPROVED BERRYMAN WATER TUBE FEED WATER HEATER AND PURIFIER

Benj. F. Kelley & Son - Makers

91 Liberty Street, NEW YORK

The Simonds Steam Receiver and Separator



IS BUILT TO FIT ALL CONDITIONS OF PIPE CONNECTIONS, AND EACH IS PORTIONED TO THE CONDITIONS UNDER WHICH IT IS TO OPERATE.

Manufactured By

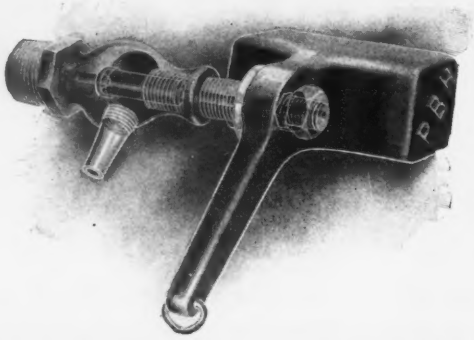
FRANK A. SIMONDS

421 HOUSEMAN BUILDING **GRAND RAPIDS, MICH.**

GET ONE FREE

Put it on your boiler, and give it a good trial for a month; if it gives you absolute satisfaction, keep it, and pay for it, otherwise send it back at our expense.

"P. B. H." WEIGHT GAUGE COCK



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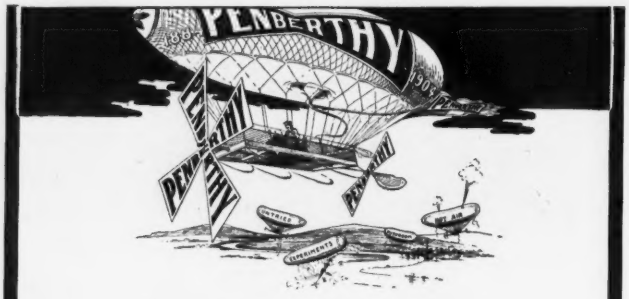

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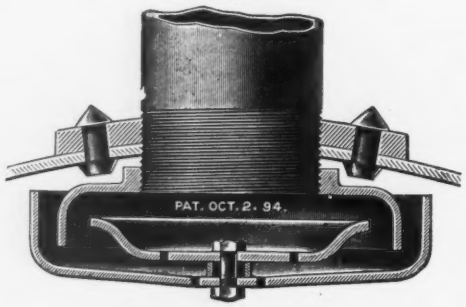

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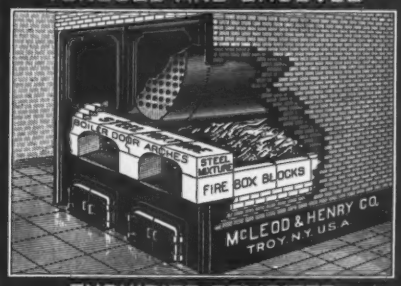

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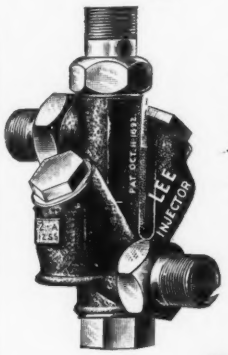

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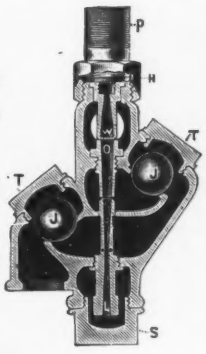

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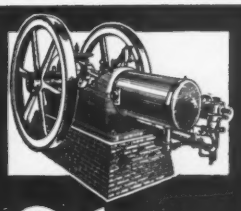

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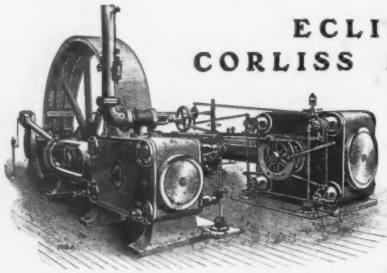

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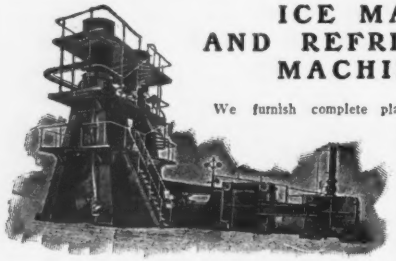

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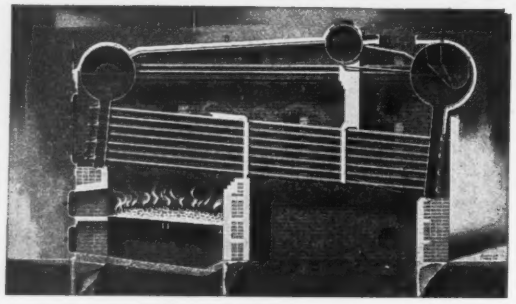

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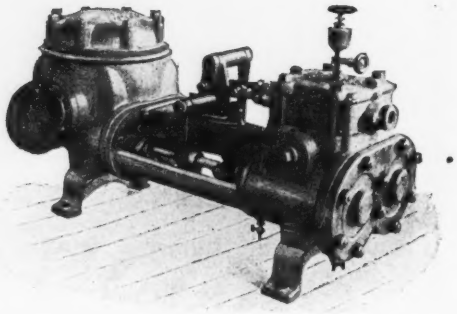

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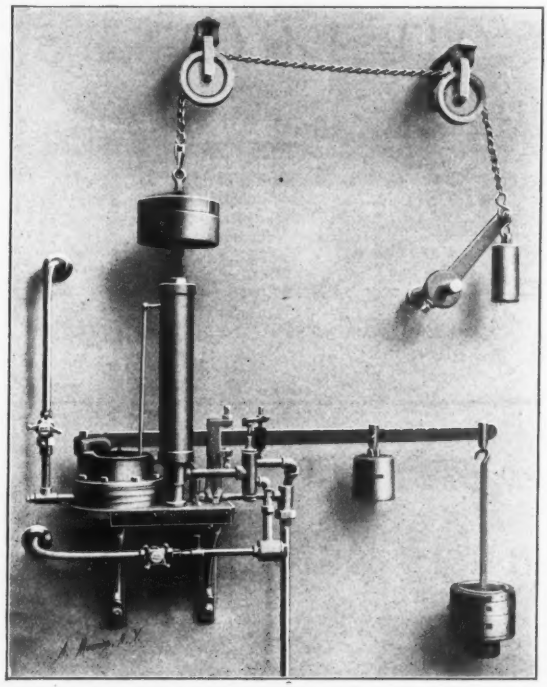

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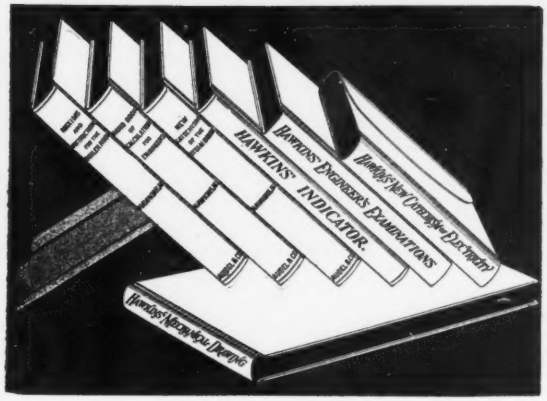

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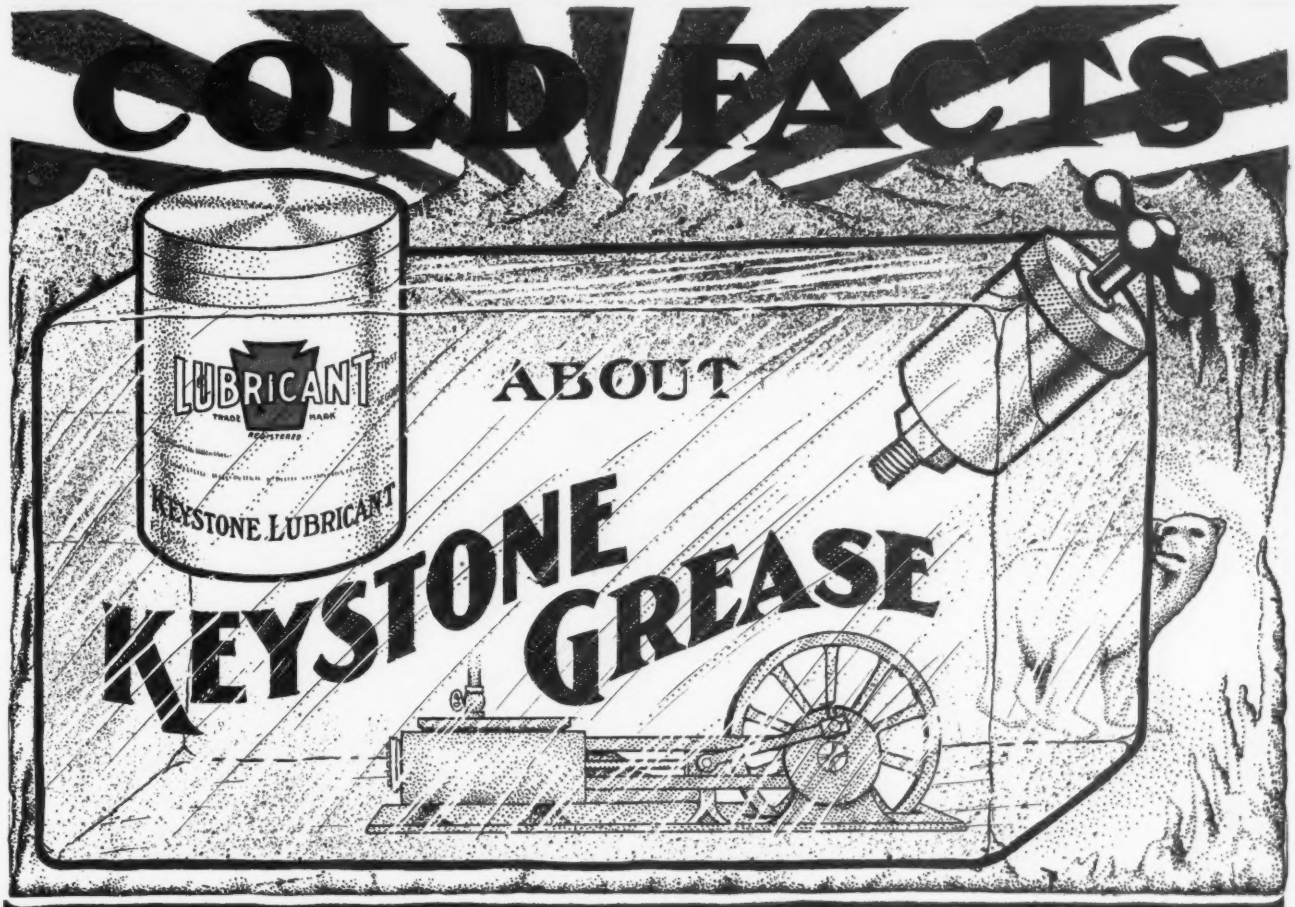

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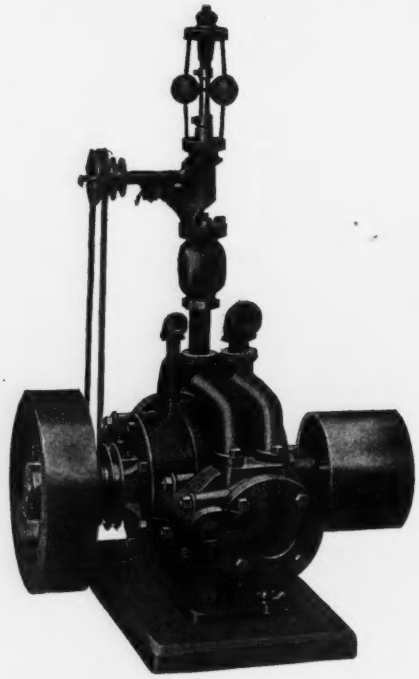

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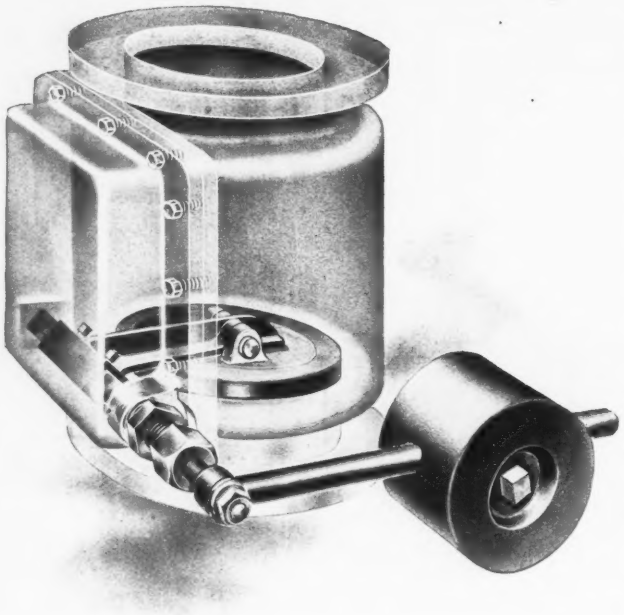

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